COMPOSITIONS USEFUL AS INHIBITORS OF JAK AND OTHER PROTEIN KINASES

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] The present application claims priority under 35 U.S.C. § 119(e) to U.S. Provisional Application numbers 60/422,973, filed November 1, 2002, entitled "Compositions Useful as Inhibitors of Jak and Other Protein Kinases, the entire contents of which is hereby incorporated by reference.

TECHNICAL FIELD OF INVENTION

[0002] The present invention relates to compounds useful as inhibitors of protein kinases. The invention also provides pharmaceutically acceptable compositions comprising the compounds of the invention and methods of using the compositions in the treatment of various disorders.

BACKGROUND OF THE INVENTION

[0003] The search for new therapeutic agents has been greatly aided in recent years by a better understanding of the structure of enzymes and other biomolecules associated with diseases. One important class of enzymes that has been the subject of extensive study is protein kinases.

[0004] Protein kinases constitute a large family of structurally related enzymes that are responsible for the control of a variety of signal transduction processes within the cell. (See, Hardie, G. and Hanks, S. *The Protein Kinase Facts Book, I and II,* Academic Press, San Diego, CA: 1995). Protein kinases are thought to have evolved from a common ancestral gene due to the conservation of their structure and catalytic function. Almost all kinases contain a similar 250-300 amino acid catalytic domain. The kinases may be categorized into families by the substrates they phosphorylate (e.g., protein-tyrosine, protein-serine/threonine, lipids, etc.). Sequence motifs have been identified that generally correspond to each of these kinase families (See, for example, Hanks, S.K., Hunter, T., *FASEB J.* **1995**, *9*, 576-596; Knighton *et al., Science*

1991, *253*, 407-414; Hiles *et al., Cell* **1992**, *70*, 419-429; Kunz *et al., Cell* **1993,** *73*, 585-596; Garcia-Bustos *et al., EMBO J.* **1994**, *13*, 2352-2361).

[0005] Many diseases are associated with abnormal cellular responses triggered by protein kinase-mediated events. These diseases include autoimmune diseases, inflammatory diseases, bone diseases, metabolic diseases, neurological and neurodegenerative diseases, cancer, cardiovascular diseases, allergies and asthma, Alzheimer's disease and hormone-related diseases. Accordingly, there has been a substantial effort in medicinal chemistry to find protein kinase inhibitors that are effective as therapeutic agents.

[0006] The Janus kinases (JAK) are a family of tyrosine kinases consisting of JAK1, JAK2, JAK3 and TYK2. The JAKs play a critical role in cytokine signaling. The down-stream substrates of the JAK family of kinases include the signal transducer and activator of transcription (STAT) proteins. JAK/STAT signaling has been implicated in the mediation of many abnormal immune responses such as allergies, asthma, autoimmune diseases such as transplant rejection, rheumatoid arthritis, amyotrophic lateral sclerosis and multiple sclerosis as well as in solid and hematologic malignancies such as leukemias and lymphomas. The pharmaceutical intervention in the JAK/STAT pathway has been reviewed [*Frank Mol. Med.* **5**, 432-456 (1999) & Seidel, et al, *Oncogene* **19**, 2645-2656 (2000)].

[0007] JAK1, JAK2, and TYK2 are ubiquitously expressed, while JAK3 is predominantly expressed in hematopoietic cells. JAK3 binds exclusively to the common cytokine receptor gamma chain (γ_c) and is activated by IL-2, IL-4, IL-7, IL-9, and IL-15. The proliferation and survival of murine mast cells induced by IL-4 and IL-9 have, in fact, been shown to be dependent on JAK3- and γ_c- signaling [Suzuki et al, *Blood* **96**, 2172-2180 (2000)].

[0008] Cross-linking of the high-affinity immunoglobulin (Ig) E receptors of sensitized mast cells leads to a release of proinflammatory mediators, including a number of vasoactive cytokines resulting in acute allergic, or immediate (type I) hypersensitivity reactions [Gordon et al, *Nature* **346**, 274-276 (1990) & Galli, *N. Engl. J. Med.*, **328**, 257-265 (1993)]. A crucial role for JAK3 in IgE receptor-mediated mast cell responses *in vitro* and *in vivo* has been established [Malaviya, et al, *Biochem. Biophys. Res. Commun.* **257**, 807-813 (1999)]. In addition, the prevention of type I hypersensitivity reactions, including anaphylaxis, mediated by mast cell-activation through inhibition of JAK3 has also been reported [Malaviya et al, *J. Biol. Chem.* **274**,27028-27038 (1999)]. Targeting mast cells with JAK3 inhibitors modulated mast cell

degranulation *in vitro* and prevented IgE receptor/antigen-mediated anaphylactic reactions *in vivo*.

[0009] A recent study described the successful targeting of JAK3 for immune suppression and allograft acceptance. The study demonstrated a dose-dependent survival of Buffalo heart allograft in Wistar Furth recipients upon administration of inhibitors of JAK3 indicating the possibility of regulating unwanted immune responses in graft versus host disease [Kirken, *Transpl. Proc.* **33**, 3268-3270 (2001)].

[0010] IL-4-mediated STAT-phosphorylation has been implicated as the mechanism involved in early and late stages of rheumatoid arthritis (RA). Up-regulation of proinflammatory cytokines in RA synovium and synovial fluid is a characteristic of the disease. It has been demostrated that IL-4–mediated activation of IL-4/STAT pathway is mediated through the Janus Kinases (JAK 1 & 3) and that IL-4-associated JAK kinases are expressed in the RA synovium [Muller-Ladner, et al, *J. Immunol.* **164,** 3894-3901 (2000)].

[0011] Familial amyotrophic lateral sclerosis (FALS) is a fatal neurodegenerative disorder affecting about 10% of ALS patients. The survival rates of FALS mice were increased upon treatment with a JAK3 specific inhibitor. This suggested that JAK3 plays a role in FALS [Trieu, et al, *Biochem. Biophys. Res. Commun.* **267**, 22-25 (2000)].

[0012] Signal transducer and activator of transcription (STAT) proteins are activated by, among others, the JAK family kinases. Results form a recent study suggested the possibility of intervention in the JAK/STAT signaling pathway by targeting JAK family kinases with specific inhibitors for the treatment of leukemia [Sudbeck, et al, *Clin. Cancer Res.* **5**, 1569-1582 (1999)]. JAK3 specific compounds were shown to inhibit the clonogenic growth of JAK3-expressing cell lines DAUDI, RAMOS, LC1;19, NALM-6, MOLT-3 and HL-60.

[0013] In animal models, TEL/JAK2 fusion proteins have induced myeloproliferative disorders and in hematopoietic cell lines, introduction of TEL/JAK2 resulted in activation of STAT1, STAT3, STAT5, and cytokine-independent growth [Schwaller, et al, *EMBO J.* **17,** 5321-5333 (1998)].

[0014] Inhibition of JAK 3 and TYK 2 abrogated tyrosine phosphorylation of STAT3, and inhibited cell growth of mycosis fungoides, a form of cutaneous T cell lymphoma. These results implicated JAK family kinases in the constitutively activated JAK/STAT pathway that is present in mycosis fungoides [Nielsen, et al, *Proc. Nat. Acad. Sci. U.S.A.* **94**, 6764-6769 (1997)].

Similarly, STAT3, STAT5, JAK1 and JAK2 were demonstrated to be constitutively activated in mouse T cell lymphoma characterized initially by LCK over-expression, thus further implicating the JAK/STAT pathway in abnormal cell growth [Yu, et al, *J. Immunol.* **159,** 5206-5210 (1997)]. In addition, IL-6 –mediated STAT3 activation was blocked by an inhibitor of JAK, leading to sensitization of myeloma cells to apoptosis [Catlett-Falcone, et al, *Immunity* **10** ,105-115 (1999)].

[0015] Cyclin-dependent kinases (CDKs) are serine/threonine protein kinases consisting of a β-sheet rich amino-terminal lobe and a larger carboxy-terminal lobe which is largely α-helical. The CDKs display the 11 subdomains shared by all protein kinases and range in molecular mass from 33 to 44 kD. This family of kinases, which includes CDK1, CKD2, CDK4, and CDK6, requires phosphorylation at the residue corresponding to CDK2 Thr160 in order to be fully active [Meijer, L., *Drug Resistance Updates*, **3**, 83-88 (2000)].

[0016] Each CDK complex is formed from a regulatory cyclin subunit (e.g., cyclin A, B1, B2, D1, D2, D3, and E) and a catalytic kinase subunit (e.g., CDK1, CDK2, CDK4, CDK5, and CDK6). Each different kinase/cyclin pair functions to regulate the different and specific phases of the cell cycle known as the G1, S, G2, and M phases [Nigg, E., *Nature Reviews*, **2**, 21-32 (2001); Flatt, P., Pietenpol, J., *Drug Metabolism Reviews*, **32**, 283-305 (2000)].

[0017] The CDKs have been implicated in cell proliferation disorders, particularly in cancer. Cell proliferation is a result of the direct or indirect deregulation of the cell division cycle and the CDKs play a critical role in the regulation of the various phases of this cycle. For example, the over-expression of cyclin D1 is commonly associated with numerous human cancers including breast, colon, hepatocellular carcinomas and gliomas [Flatt, P., Pietenpol, J., *Drug Metabolism Reviews*, **32**, 283-305 (2000)]. The CDK2/cyclin E complex plays a key role in the progression from the early G_1 to S phases of the cell cycle and the overexpression of cyclin E has been associated with various solid tumors. Therefore, inhibitors of cyclins D1, E, or their associated CDKs are useful targets for cancer therapy [Kaubisch, A., Schwartz, G., *The Cancer Journal*, **6**, 192-212 (2000)].

[0018] CDKs, especially CDK2, also play a role in apoptosis and T-cell development. CDK2 has been identified as a key regulator of thymocyte apoptosis [Williams, O., et al, *European Journal of Immunology*, 709-713 (2000)]. Stimulation of CDK2 kinase activity is associated with the progression of apoptosis in thymocytes, in response to specific stimuli.

Inhibition of CDK2 kinase activity blocks this apoptosis resulting in the protection of thymocytes.

[0019] In addition to regulating the cell cycle and apoptosis, the CDKs are directly involved in the process of transcription. Numerous viruses require CDKs for their replication process. Examples where CDK inhibitors restrain viral replication include human cytomegakovirus, herpes virus, and varicella-zoster virus [Meijer, L., *Drug Resistance Updates*, **3**, 83-88 (2000)].

[0020] Inhibition of CDK is also useful for the treatment of neurodegenerative disorders such as Alzheimer's disease. The appearance of Paired Helical Filaments (PHF), associated with Alzheimer's disease, is caused by the hyperphosphorylation of Tau protein by CDK5/p25 [Meijer, L., *Drug Resistance Updates*, **3**, 83-88 (2000)].

[0021] JNK is a member of the mitogen-activated protein (MAP) kinase family. MAP kinases (MAPKs) are activated by a variety of signals including growth factors, cytokines, UV radiation, and stress-inducing agents. MAPKs are serine/threonine kinases and their activation occur by dual phosphorylation of threonine and tyrosine at the Thr-X-Tyr segment in the activation loop. MAPKs phosphorylate various substrates including transcription factors, which in turn regulate the expression of specific sets of genes and thus mediate a specific response to the stimulus.

[0022] Three distinct genes, JNK1, JNK2, JNK3 have been identified for this kinase family and at least ten different splicing isoforms of JNKs exist in mammalian cells [Gupta et al., *EMBO J.*, **15**, 2760-70 (1996)]. Members of the JNK family are activated by proinflammatory cytokines, such as tumor necrosis factor-α (TNFα) and interleukin-1 β (IL-1β), as well as by environmental stress, including anisomycin, UV irradiation, hypoxia, and osmotic shock [Minden et al., *Biochemica et Biophysica Acta*, **1333**, F85-F104 (1997)].

[0023] The down-stream substrates of JNKs include transcription factors c-Jun, ATF-2, Elk1, p53 and a cell death domain protein (DENN) [Zhang et al. *Proc. Natl. Acad. Sci. USA*, **95**, 2586-91 (1998)]. Each JNK isoform binds to these substrates with different affinities, suggesting a regulation of signaling pathways by substrate specificity of different JNKs *in vivo* (Gupta et al., *supra*).

[0024] JNKs, along with other MAPKs, have been implicated in having a role in mediating cellular response to cancer, thrombin-induced platelet aggregation, immunodeficiency disorders, autoimmune diseases, cell death, allergies, osteoporosis and heart disease. The therapeutic

targets related to activation of the JNK pathway include chronic myelogenous leukemia (CML), rheumatoid arthritis, asthma, osteoarthritis, ischemia, cancer and neurodegenerative diseases.

[0025] Several reports have detailed the importance of JNK activation associated with liver disease or episodes of hepatic ischemia [*Nat. Genet.* **21**, 326-9 (1999); *FEBS Lett.* **420**, 201-4 (1997); *J. Clin. Invest.* **102**, 1942-50 (1998); *Hepatology* **28**, 1022-30 (1998)]. Therefore, inhibitors of JNK may be useful to treat various hepatic disorders.

[0026] A role for JNK in cardiovascular disease such as myocardial infarction or congestive heart failure has also been reported as it has been shown JNK mediates hypertrophic responses to various forms of cardiac stress [*Circ. Res.* **83**, 167-78 (1998); *Circulation* **97**, 1731-7 (1998); *J. Biol. Chem.* **272**, 28050-6 (1997); *Circ. Res.* **79**, 162-73 (1996); *Circ. Res.* **78**, 947-53 (1996); *J. Clin. Invest.* **97**, 508-14 (1996)].

[0027] It has been demonstrated that the JNK cascade also plays a role in T-cell activation, including activation of the IL-2 promoter. Thus, inhibitors of JNK may have therapeutic value in altering pathologic immune responses [*J. Immunol.* **162**, 3176-87 (1999); *Eur. J. Immunol.* **28**, 3867-77 (1998); *J. Exp. Med.* **186**, 941-53 (1997); *Eur. J. Immunol.* **26**, 989-94 (1996)].

[0028] A role for JNK activation in various cancers has also been established, suggesting the potential use of JNK inhibitors in cancer. For example, constitutively activated JNK is associated with HTLV-1 mediated tumorigenesis [*Oncogene* **13**, 135-42 (1996)]. JNK may play a role in Kaposi's sarcoma (KS) because it is thought that the proliferative effects of bFGF and OSM on KS cells are mediated by their activation of the JNK signaling pathway [*J. Clin. Invest.* **99**, 1798-804 (1997)]. Other proliferative effects of other cytokines implicated in KS proliferation, such as vascular endothelial growth factor (VEGF), IL-6 and TNFα, may also be mediated by JNK. In addition, regulation of the c-jun gene in p210 BCR-ABL transformed cells corresponds with activity of JNK, suggesting a role for JNK inhibitors in the treatment for chronic myelogenous leukemia (CML) [*Blood* **92**, 2450-60 (1998)].

[0029] JNK1 and JNK2 are widely expressed in a variety of tissues. In contrast, JNK3 is selectively expressed in the brain and to a lesser extent in the heart and testis [Gupta et al., *supra*; Mohit et al., *Neuron* **14**, 67-78 (1995); Martin et al., *Brain Res. Mol. Brain Res.* **35**, 47-57 (1996)]. JNK3 has been linked to neuronal apoptosis induced by kainic acid, indicating a role of JNK in the pathogenesis of glutamate neurotoxicity. In the adult human brain, JNK3 expression is localized to a subpopulation of pyramidal neurons in the CA1, CA4 and subiculum regions of

the hippocampus and layers 3 and 5 of the neocortex [Mohit et al., *supra*]. The CA1 neurons of patients with acute hypoxia showed strong nuclear JNK3-immunoreactivity compared to minimal, diffuse cytoplasmic staining of the hippocampal neurons from brain tissues of normal patients [Zhang et al., *supra*]. Thus, JNK3 appears to be involved involved in hypoxic and ischemic damage of CA1 neurons in the hippocampus.

[0030] In addition, JNK3 co-localizes immunochemically with neurons vulnerable in Alzheimer's disease [Mohit et al., *supra*]. Disruption of the JNK3 gene caused resistance of mice to the excitotoxic glutamate receptor agonist kainic acid, including the effects on seizure activity, AP-1 transcriptional activity and apoptosis of hippocampal neurons, indicating that the JNK3 signaling pathway is a critical component in the pathogenesis of glutamate neurotoxicity (Yang et al., *Nature,* **389**, ,865-870 (1997)].

[0031] Based on these findings, JNK signalling, especially that of JNK3, has been implicated in the areas of apoptosis-driven neurodegenerative diseases such as Alzheimer's Disease, Parkinson's Disease, ALS (Amyotrophic Lateral Sclerosis), epilepsy and seizures, Huntington's Disease, traumatic brain injuries, as well as ischemic and hemorrhaging stroke.

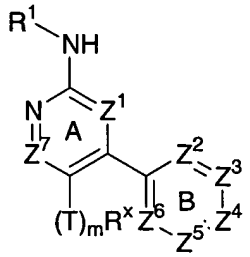
[0032] ZAP-70 is essential for T cell receptor signalling. Expression of this tyrosine kinase is restricted to T-cells and natural killer cells. The importance of ZAP-70 in T-cell function has been demonstrated in human patients, human T-cell lines and mice. Human patients suffering from a rare form of severe combined deficiency syndrome (SCID) possess homozygous mutations in ZAP-70 (reviewed in Elder J. of pedriatric hematology/oncology 19(6) 546-550 1997). These patients have profound immunodeficiency, lack CD8+ T cells and have CD4+ T cells that are unresponsive to T cell receptor (TCR)-mediated stimulation. Following TCR activation these CD4+ cells show severe defects in Ca2+ mobilization, tyrosine phosphorylation of down-stream substrates, proliferation and IL-2 production 70 (reviewed in Elder Pedriatric research 39, 743-748). Human Jurkat cells lacking ZAP-70 also provide important insights into the critical role of ZAP-70 in T cell receptor signalling. A Jurkat clone (p116) with no detectable ZAP-70 protein was shown to have defects in T cell receptor signalling which could be corrected by re-introduction of wt ZAP-70 (Williams et al Molecular and Cellular Biology 18 (3), 1388-1399 1998). Studies of mice lacking ZAP-70 also demonstrate a requirement of ZAP-70 in T-cell receptor signalling. Zap-70-deficient mice have profound defects in T cell development and T cell receptor signalling in thymocytes is impaired (Negishi et al, Nature 376, 435-438 1995).

[0033] The importance of the kinase domain in ZAP-70 function is demonstrated by studies of human patients and mice expressing identical mutations in the DLAARN motif within the kinase domain of ZAP-70. Inactivation of kinase activity by this mutation results in defective T cell receptor signalling (Elder et al J. Immunology 656-661 2001). Catalytically inactive ZAP-70 (Lys369Arg) was also defective in restoring T cell receptor signalling in a ZAP-70 deficient Jurkat cell clone (p116) (Williams et al Molecular and Cellular Biology 18 (3), 1388-1399 1998).

[0034] Accordingly, there is a great need to develop inhibitors of JAK, JNK, CDK, and ZAP-70 protein kinases that are useful in treating various diseases or conditions associated with JAK, JNK, CDK, and ZAP-70 activation, particularly given the inadequate treatments currently available for the majority of these disorders.

SUMMARY OF THE INVENTION

[0035] It has now been found that compounds of this invention, and pharmaceutically acceptable compositions thereof, are effective as inhibitors of JAK, JNK, CDK, and ZAP-70 protein kinases. In certain embodiments, these compounds are effective as inhibitors of JAK3, JNK3, CDK2, and ZAP-70 protein kinases. These compounds have the general formula **I:**



I

or a pharmaceutically acceptable salt thereof, wherein R^1, T, R^X, m, Z^1, Z^2, Z^3, Z^4, Z^5, Z^6, and Z^7 are as defined below.

[0036] These compounds and pharmaceutical compositions thereof are useful for treating or preventing a variety of disorders, such as heart disease, diabetes, Alzheimer's disease, immunodeficiency disorders, inflammatory diseases, allergic diseases, autoimmune diseases, destructive bone disorders such as osteoporosis, proliferative disorders, infectious diseases, immunologically-mediated diseases, and viral diseases. The compositions are also useful in methods for preventing cell death and hyperplasia and therefore may be used to treat or prevent reperfusion/ischemia in stroke, heart attacks, and organ hypoxia. The compositions are also

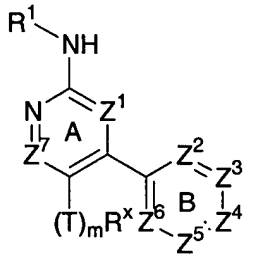
useful in methods for preventing thrombin-induced platelet aggregation. The compositions are especially useful for disorders such as chronic myelogenous leukemia (CML), rheumatoid arthritis, asthma, osteoarthritis, ischemia, cancer, liver disease including hepatic ischemia, heart disease such as myocardial infarction and congestive heart failure, pathologic immune conditions involving T cell activation, and neurodegenerative disorders.

[0037] The compounds provided by this invention are also useful for the study of kinases in biological and pathological phenomena; the study of intracellular signal transduction pathways mediated by such kinases, and the comparative evaluation of new kinase inhibitors.

DETAILED DESCRIPTION OF THE INVENTION

[0038] *I. General Description of Compounds of the Invention:*

[0039] The present invention relates to a compound of formula **I**:



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or a pharmaceutically acceptable salt thereof,

wherein:

R^1 is Q-Ar^1,

wherein Q is a C_{1-2} alkylidene chain wherein one methylene unit of Q is optionally replaced by O, NR, NRCO, NRCONR, $NRCO_2$, CO, CO_2, CONR, OC(O)NR, SO_2, SO_2NR, $NRSO_2$, $NRSO_2NR$, C(O)C(O), or $C(O)CH_2C(O)$;

Ar^1 is a 5-7 membered saturated, partially unsaturated, or fully unsaturated monocyclic ring having 0-3 heteroatoms independently selected from nitrogen, oxygen, or sulfur, or an 8-12 membered saturated, partially unsaturated, or fully unsaturated bicyclic ring system having 0-5 heteroatoms independently selected from nitrogen, oxygen, or sulfur; wherein Ar^1 is optionally substituted with q independent occurrences of Z-R^Z; wherein q is 0-5, Z is a

bond or is a C_1-C_6 alkylidene chain wherein up to two non-adjacent methylene units of Z are optionally and independently replaced by CO, CO_2, COCO, CONR, OCONR, NRNR, NRNRCO, NRCO, $NRCO_2$, NRCONR, SO, SO_2, $NRSO_2$, SO_2NR, $NRSO_2NR$, O, S, or NR; and each occurrence of R^Z is independently selected from R', halogen, NO_2, CN, OR', SR', $N(R')_2$, NR'COR', $NR'CON(R')_2$, $NR'CO_2R'$, COR', CO_2R', OCOR', $CON(R')_2$, $OCON(R')_2$, SOR', SO_2R', $SO_2N(R')_2$, $NR'SO_2R'$, $NR'SO_2N(R')_2$, COCOR', or $COCH_2COR'$;

each occurrence of R is independently hydrogen or an optionally substituted C_{1-6} aliphatic group; and each occurrence of R' is independently hydrogen or an optionally substituted C_{1-6} aliphatic group, a 3-8-membered saturated, partially unsaturated, or fully unsaturated monocyclic ring having 0-3 heteroatoms independently selected from nitrogen, oxygen, or sulfur, or an 8-12 membered saturated, partially unsaturated, or fully unsaturated bicyclic ring system having 0-5 heteroatoms independently selected from nitrogen, oxygen, or sulfur; or R and R', two occurrences of R, or two occurrences of R', are taken together with the atom(s) to which they are bound to form an optionally substituted 3-12 membered saturated, partially unsaturated, or fully unsaturated monocyclic or bicyclic ring having 0-4 heteroatoms independently selected from nitrogen, oxygen, or sulfur;

Z^1 is N or CH;

Z^7 is N or $C(U)_nR^Y$;

T and U are each independently a bond or a saturated or unsaturated C_{1-6} alkylidene chain, wherein up to two methylene units of the chain are optionally and independently replaced by CO, CO_2, COCO, CONR, OCONR, NRNR, NRNRCO, NRCO, $NRCO_2$, NRCONR, SO, SO_2, $NRSO_2$, SO_2NR, $NRSO_2NR$, O, S, or NR;

m and n are each independently 0 or 1;

R^X and R^Y are each independently selected from R or Ar^1;

Z^2 is N or CR^2; Z^3 is N or CR^3; Z^4 is N or CR^4; Z^5 is N or CR^5; and Z^6 is N or CR^6, wherein each occurrence of R^2, R^3, R^4, R^5 or R^6 is independently R^U or $(V)_pR^V$, provided that a) no more than three of Z^2, Z^3, Z^4, Z^5 or Z^6 is N, and b) at least one of Z^3, Z^4 or Z^5 is CR^3, CR^4, or CR^5, respectively, and at least one of R^3, R^4, or R^5 is R^U,

each occurrence of R^U is $NRCOR^7$, $CONR(R^7)$, $SO_2NR(R^7)$, $NRSO_2R^7$, $NRCONR(R^7)$, $NRSO_2NR(R^7)$, or $CONRNR(R^7)$, wherein R^7 is $(CH_2)_t$-Y-R^8, and t is 0, 1, or 2, Y is a bond

or is O, S, NR^9, $-OCH_2-$, $-SCH_2$, $-NR^9CH_2$, $O(CH_2)_2-$, $-S(CH_2)_2$, or $-NR^9(CH_2)_2$, and R^8 is Ar^2, or R^8 and R^9, taken together with the nitrogen atom, form an optionally substituted 5-8 membered heterocyclyl or heteroaryl ring having 1-3 heteroatoms independently selected from nitrogen, oxygen or sulfur;

each occurrence of V is a bond or a saturated or unsaturated C_{1-6} alkylidene chain, wherein up to two methylene units of the chain are optionally and independently replaced by CO, CO_2, COCO, CONR, OCONR, NRNR, NRNRCO, NRCO, $NRCO_2$, NRCONR, SO, SO_2, $NRSO_2$, SO_2NR, $NRSO_2NR$, O, S, or NR;

each occurrence of p is 0 or 1;

each occurrence of R^V is R or Ar^2; and

Ar^2 is a 5-7 membered saturated, partially unsaturated, or fully unsaturated monocyclic ring having 0-3 heteroatoms independently selected from nitrogen, oxygen, or sulfur, or an 8-12 membered saturated, partially unsaturated, or fully unsaturated bicyclic ring system having 0-5 heteroatoms independently selected from nitrogen, oxygen, or sulfur; wherein Ar^2 is optionally substituted with r independent occurrences of $W\text{-}R^W$; wherein r is 0-3, W is a bond or is a C_1-C_6 alkylidene chain wherein up to two non-adjacent methylene units of W are optionally replaced by CO, CO_2, COCO, CONR, OCONR, NRNR, NRNRCO, NRCO, $NRCO_2$, NRCONR, SO, SO_2, $NRSO_2$, SO_2NR, $NRSO_2NR$, O, S, or NR; and each occurrence of R^W is independently selected from R', halogen, NO_2, CN, OR', SR', $N(R')_2$, NR'COR', $NR'CON(R')_2$, $NR'CO_2R'$, COR', CO_2R', OCOR', $CON(R')_2$, $OCON(R')_2$, SOR', SO_2R', $SO_2N(R')_2$, $NR'SO_2R'$, $NR'SO_2N(R')_2$, COCOR', or $COCH_2COR'$;

provided that:

a) when Z^1 is N, Z^7 is CH; and ring B is phenyl and at least one of R^3 or R^4 is $NHCOR^7$, then R^1 is not phenyl only substituted with two or three occurrences of OR'; and

b) when Z^1 is N, Z^7 is CH; and ring B is phenyl and at least one of R^3 of R^4 is $NHCOR^7$, SO_2R^7, $CONRR^7$, then R^1 is not phenyl only substituted with one occurrence of $-CON(R')_2$ in the para position.

[0040] In certain embodiments, for compounds of formula **I** described generally above, and classes and subclasses thereof described herein, compounds where R^1 is phenyl substituted only by three occurrences of OR' are excluded.

[0041] In certain other embodiments, for the compounds of formula **I** described generally above, and classes and subclasses thereof described herein, compounds where R^1 is phenyl substituted only by two occurrences of OR' are excluded.

[0042] In yet other embodiments, for compounds of formula **I** described generally above, and classes and subclasses thereof described herein, compounds where ring A is phenyl substituted in the meta position by nitro, fluorine-substituted lower alkoxy, or –NRCOR' are excluded.

[0043] In certain other embodiments, for the compounds of formula **I** described generally abbove, and classes and subclasses thereof described herein, compounds where R^1 is phenyl substituted by nitro, fluorine-substituted lower alkoxy, or –NRCOR' are excluded.

[0044] In still other embodiments, for compounds of formula **I** described generally above, and classes and subclasses thereof described herein, compounds where $(T)_mR^x$ is cyano are excluded.

[0045] In yet other embodiments, for compounds of formula **I** described generally above, and classes and subclasses thereof described herein, compounds where $(T)_mR^x$ is halogen are excluded.

[0046] In certain other embodiments, for compounds of formula **I** described generally above, and classes and subclasses thereof described herein, compounds where $(T)_mR^x$ is alkynyl are excluded.

[0047] In yet other embodiments, for compounds of formula **I** described generally above, and classes and subclasses thereof described herein, compounds where R^1 is 4-Me, 5-COOEt-thiazol-2-yl, ring B is 4-NHCOOEt-phenyl, or 4-NHCOCF$_3$-phenyl, and Z^7 is C-(4-OH-1-piperidinyl) are excluded.

[0048] *2. Compounds and Definitions:*

[0049] Compounds of this invention include those described generally above, and are further illustrated by the classes, subclasses, and species disclosed herein. As used herein, the following definitions shall apply unless otherwise indicated. For purposes of this invention, the chemical

elements are identified in accordance with the Periodic Table of the Elements, CAS version, Handbook of Chemistry and Physics, 75th Ed. Additionally, general principles of organic chemistry are described in "Organic Chemistry", Thomas Sorrell, University Science Books, Sausalito: 1999, and "March's Advanced Organic Chemistry", 5th Ed., Ed.: Smith, M.B. and March, J., John Wiley & Sons, New York: 2001, the entire contents of which are hereby incorporated by reference.

[0050] As described herein, compounds of the invention may optionally be substituted with one or more substituents, such as are illustrated generally above, or as exemplified by particular classes, subclasses, and species of the invention. It will be appreciated that the phrase "optionally substituted" is used interchangeably with the phrase "substituted or unsubstituted." In general, the term "substituted", whether preceded by the term "optionally" or not, refers to the replacement of hydrogen radicals in a given structure with the radical of a specified substituent. Unless otherwise indicated, an optionally substituted group may have a substituent at each substitutable position of the group, and when more than one position in any given structure may be substituted with more than one substituent selected from a specified group, the substituent may be either the same or different at every position. Combinations of substituents envisioned by this invention are preferably those that result in the formation of stable or chemically feasible compounds. The term "stable", as used herein, refers to compounds that are not substantially altered when subjected to conditions to allow for their production, detection, and preferably their recovery, purification, and use for one or more of the purposes disclosed herein. In some embodiments, a stable compound or chemically feasible compound is one that is not substantially altered when kept at a temperature of 40°C or less, in the absence of moisture or other chemically reactive conditions, for at least a week.

[0051] The term "aliphatic" or "aliphatic group", as used herein, means a straight-chain (i.e., unbranched) or branched, substituted or unsubstituted hydrocarbon chain that is completely saturated or that contains one or more units of unsaturation, or a monocyclic hydrocarbon or bicyclic hydrocarbon that is completely saturated or that contains one or more units of unsaturation, but which is not aromatic (also referred to herein as "carbocycle" "cycloaliphatic" or "cycloalkyl"), that has a single point of attachment to the rest of the molecule. Unless otherwise specified, aliphatic groups contain 1-20 aliphatic carbon atoms. In some embodiments, aliphatic groups contain 1-10 aliphatic carbon atoms. In other embodiments,

aliphatic groups contain 1-8 aliphatic carbon atoms. In still other embodiments, aliphatic groups contain 1-6 aliphatic carbon atoms, and in yet other embodiments aliphatic groups contain 1-4 aliphatic carbon atoms. In some embodiments, "cycloaliphatic" (or "carbocycle" or "cycloalkyl") refers to a monocyclic C_3-C_8 hydrocarbon or bicyclic C_8-C_{12} hydrocarbon that is completely saturated or that contains one or more units of unsaturation, but which is not aromatic, that has a single point of attachment to the rest of the molecule wherein any individual ring in said bicyclic ring system has 3-7 members. Suitable aliphatic groups include, but are not limited to, linear or branched, substituted or unsubstituted alkyl, alkenyl, alkynyl groups and hybrids thereof such as (cycloalkyl)alkyl, (cycloalkenyl)alkyl or (cycloalkyl)alkenyl.

[0052] The term "heteroaliphatic", as used herein, means aliphatic groups wherein one or two carbon atoms are independently replaced by one or more of oxygen, sulfur, nitrogen, phosphorus, or silicon. Heteroaliphatic groups may be substituted or unsubstituted, branched or unbranched, cyclic or acyclic, and include "heterocycle", "heterocyclyl", "heterocycloaliphatic", or "heterocyclic" groups.

[0053] The term "heterocycle", "heterocyclyl", "heterocycloaliphatic", or "heterocyclic" as used herein means non-aromatic, monocyclic, bicyclic, or tricyclic ring systems in which one or more ring members are an independently selected heteroatom. In some embodiments, the "heterocycle", "heterocyclyl", "heterocycloaliphatic", or "heterocyclic" group has three to fourteen ring members in which one or more ring members is a heteroatom independently selected from oxygen, sulfur, nitrogen, or phosphorus, and each ring in the system contains 3 to 7 ring members.

[0054] The term "heteroatom" means one or more of oxygen, sulfur, nitrogen, phosphorus, or silicon (including, any oxidized form of nitrogen, sulfur, phosphorus, or silicon; the quaternized form of any basic nitrogen or; a substitutable nitrogen of a heterocyclic ring, for example N (as in 3,4-dihydro-2*H*-pyrrolyl), NH (as in pyrrolidinyl) or NR^+ (as in N-substituted pyrrolidinyl)).

[0055] The term "unsaturated", as used herein, means that a moiety has one or more units of unsaturation.

[0056] The term "alkoxy", or "thioalkyl", as used herein, refers to an alkyl group, as previously defined, attached to the principal carbon chain through an oxygen ("alkoxy") or sulfur ("thioalkyl") atom.

[0057] The terms "haloalkyl", "haloalkenyl" and "haloalkoxy" means alkyl, alkenyl or alkoxy, as the case may be, substituted with one or more halogen atoms. The term "halogen" means F, Cl, Br, or I.

[0058] The term "aryl" used alone or as part of a larger moiety as in "aralkyl", "aralkoxy", or "aryloxyalkyl", refers to monocyclic, bicyclic, and tricyclic ring systems having a total of five to fourteen ring members, wherein at least one ring in the system is aromatic and wherein each ring in the system contains 3 to 7 ring members. The term "aryl" may be used interchangeably with the term "aryl ring". The term "aryl" also refers to heteroaryl ring systems as defined hereinbelow.

[0059] The term "heteroaryl", used alone or as part of a larger moiety as in "heteroaralkyl" or "heteroarylalkoxy", refers to monocyclic, bicyclic, and tricyclic ring systems having a total of five to fourteen ring members, wherein at least one ring in the system is aromatic, at least one ring in the system contains one or more heteroatoms, and wherein each ring in the system contains 3 to 7 ring members. The term "heteroaryl" may be used interchangeably with the term "heteroaryl ring" or the term "heteroaromatic".

[0060] An aryl (including aralkyl, aralkoxy, aryloxyalkyl and the like) or heteroaryl (including heteroaralkyl and heteroarylalkoxy and the like) group may contain one or more substituents and thus may be "optionally substituted". Unless otherwise defined above and herein, suitable substituents on the unsaturated carbon atom of an aryl or heteroaryl group are generally selected from halogen; -R°; -OR°; -SR°; phenyl (Ph) optionally substituted with R°; -O(Ph) optionally substituted with R°; -$(CH_2)_{1-2}$(Ph), optionally substituted with R°; -CH=CH(Ph), optionally substituted with R°; -NO_2; -CN; -$N(R°)_2$; -NR°C(O)R°; -NR°C(S)R°; -NR°C(O)$N(R°)_2$; -NR°C(S)$N(R°)_2$; -NR°CO_2R°; -NR°NR°C(O)R°; -NR°NR°C(O)$N(R°)_2$; -NR°NR°CO_2R°; -C(O)C(O)R°; -C(O)CH_2C(O)R°; -CO_2R°; -C(O)R°; -C(S)R°; -C(O)$N(R°)_2$; -C(S)$N(R°)_2$; -OC(O)$N(R°)_2$; -OC(O)R°; -C(O)N(OR°) R°; -C(NOR°) R°; -$S(O)_2$R°; -$S(O)_3$R°; -$SO_2N(R°)_2$; -S(O)R°; -NR°$SO_2N(R°)_2$; -NR°SO_2R°; -N(OR°)R°; -C(=NH)-$N(R°)_2$; -$P(O)_2$R°; -$PO(R°)_2$; -$OPO(R°)_2$; -$(CH_2)_{0-2}$NHC(O)R°; phenyl (Ph) optionally substituted with R°; -O(Ph) optionally substituted with R°; -$(CH_2)_{1-2}$(Ph), optionally substituted with R°; or -CH=CH(Ph), optionally substituted with R°; wherein each independent occurrence of R° is selected from hydrogen, optionally substituted C_{1-6} aliphatic, an unsubstituted 5-6 membered heteroaryl or heterocyclic ring, phenyl, -O(Ph), or -CH_2(Ph), or, notwithstanding the definition above, two

independent occurrences of R°, on the same substituent or different substituents, taken together with the atom(s) to which each R° group is bound, to form an optionally substituted 3-12 membered saturated, partially unsaturated, or fully unsaturated monocyclic or bicyclic ring having 0-4 heteroatoms independently selected from nitrogen, oxygen, or sulfur.

[0061] . Optional substituents on the aliphatic group of R° are selected from NH_2, $NH(C_{1-4}$aliphatic), $N(C_{1-4}$aliphatic$)_2$, halogen, C_{1-4}aliphatic, OH, $O(C_{1-4}$aliphatic), NO_2, CN, CO_2H, $CO_2(C_{1-4}$aliphatic), $O(haloC_{1-4}$ aliphatic), or $haloC_{1-4}$aliphatic, wherein each of the foregoing C_{1-4}aliphatic groups of R° is unsubstituted.

[0062] An aliphatic or heteroaliphatic group, or a non-aromatic heterocyclic ring may contain one or more substituents and thus may be "optionally substituted". Unless otherwise defined above and herein, suitable substituents on the saturated carbon of an aliphatic or heteroaliphatic group, or of a non-aromatic heterocyclic ring are selected from those listed above for the unsaturated carbon of an aryl or heteroaryl group and additionally include the following: =O, =S, $=NNHR^*$, $=NN(R^*)_2$, $=NNHC(O)R^*$, $=NNHCO_2$(alkyl), $=NNHSO_2$(alkyl), or $=NR^*$, where each R^* is independently selected from hydrogen or an optionally substituted C_{1-6} aliphatic group.

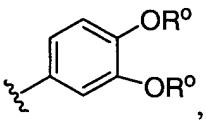
[0063] Unless otherwise defined above and herein, optional substituents on the nitrogen of a non-aromatic heterocyclic ring are generally selected from $-R^+$, $-N(R^+)_2$, $-C(O)R^+$, $-CO_2R^+$, $-C(O)C(O)R^+$, $-C(O)CH_2C(O)R^+$, $-SO_2R^+$, $-SO_2N(R^+)_2$, $-C(=S)N(R^{+1})_2$, $-C(=NH)-N(R^+)_2$, or $-NR^+SO_2R^+$; wherein R^+ is hydrogen, an optionally substituted C_{1-6} aliphatic, optionally substituted phenyl, optionally substituted -O(Ph), optionally substituted $-CH_2$(Ph), optionally substituted $-(CH_2)_{1-2}$(Ph); optionally substituted -CH=CH(Ph); or an unsubstituted 5-6 membered heteroaryl or heterocyclic ring having one to four heteroatoms independently selected from oxygen, nitrogen, or sulfur, or, notwithstanding the definition above, two independent occurrences of R^+, on the same substituent or different substituents, taken together with the atom(s) to which each R^+ group is bound, form an optionally substituted 3-12 membered saturated, partially unsaturated, or fully unsaturated monocyclic or bicyclic ring having 0-4 heteroatoms independently selected from nitrogen, oxygen, or sulfur.

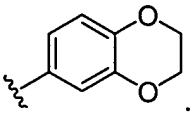
[0064] Optional substituents on the aliphatic group or the phenyl ring of R^+ are selected from $-NH_2$, $-NH(C_{1-4}$ aliphatic), $-N(C_{1-4}$ aliphatic$)_2$, halogen, C_{1-4} aliphatic, -OH, $-O(C_{1-4}$ aliphatic), -

NO_2, -CN, $-CO_2H$, $-CO_2(C_{1-4}$ aliphatic), -O(halo C_{1-4} aliphatic), or halo(C_{1-4} aliphatic), wherein each of the foregoing C_{1-4}aliphatic groups of R^+ is unsubstituted.

[0065] The term "alkylidene chain" refers to a straight or branched carbon chain that may be fully saturated or have one or more units of unsaturation and has two points of attachment to the rest of the molecule.

[0066] As detailed above, in some embodiments, two independent occurrences of R^o (or R^+, R, R' or any other variable similarly defined herein), are taken together with the atom(s) to which they are bound to form an optionally substituted 3-12 membered saturated, partially unsaturated, or fully unsaturated monocyclic or bicyclic ring having 0-4 heteroatoms independently selected from nitrogen, oxygen, or sulfur.

[0067] Exemplary rings that are formed when two independent occurrences of R^o (or R^+, R, R' or any other variable similarly defined herein), are taken together with the atom(s) to which each variable is bound include, but are not limited to the following: a) two independent occurrences of R^o (or R^+, R, R' or any other variable similarly defined herein) that are bound to the same atom and are taken together with that atom to form a ring, for example, $N(R^o)_2$, where both occurrences of R^o are taken together with the nitrogen atom to form a piperidin-1-yl, piperazin-1-yl, or morpholin-4-yl group; and b) two independent occurrences of R^o (or R^+, R, R' or any other variable similarly defined herein) that are bound to different atoms and are taken together with both of those atoms to form a ring, for example where a phenyl group is substituted with two occurrences of OR^o 

, these two occurrences of R^o are taken together with the oxygen atoms to which they are bound to form a fused 6-membered oxygen containing ring: 

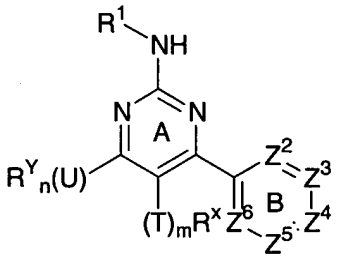
. It will be appreciated that a variety of other rings can be formed when two independent occurrences of R^o (or R^+, R, R' or any other variable similarly defined herein) are taken together with the atom(s) to which each variable is bound and that the examples detailed above are not intended to be limiting.

[0068] Unless otherwise stated, structures depicted herein are also meant to include all isomeric (e.g., enantiomeric, diastereomeric, and geometric (or conformational)) forms of the structure; for example, the R and S configurations for each asymmetric center, (Z) and (E)

double bond isomers, and (Z) and (E) conformational isomers. Therefore, single stereochemical isomers as well as enantiomeric, diastereomeric, and geometric (or conformational) mixtures of the present compounds are within the scope of the invention. Unless otherwise stated, all tautomeric forms of the compounds of the invention are within the scope of the invention. Additionally, unless otherwise stated, structures depicted herein are also meant to include compounds that differ only in the presence of one or more isotopically enriched atoms. For example, compounds having the present structures except for the replacement of hydrogen by deuterium or tritium, or the replacement of a carbon by a ^{13}C- or ^{14}C-enriched carbon are within the scope of this invention. Such compounds are useful, for example, as analytical tools or probes in biological assays.

[0069] *3. Description of Exemplary Compounds:*

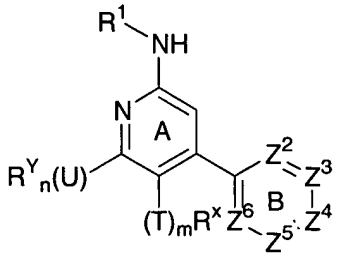
[0070] In certain exemplary embodiments, Z^1 is N and amino pyrimidines of general formula **II** are provided:



II

wherein R^1, $(U)_nR^Y$, $(T)_mR^X$, Z^2, Z^3, Z^4, Z^5, and Z^6 are as defined generally above and in classes and subclasses herein.

[0071] In certain other exemplary embodiments, Z^1 is CH and amino pyridines of general formula **III** are provided:



III

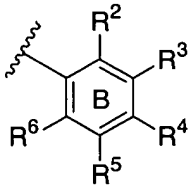
wherein R^1, $(U)_nR^Y$, $(T)_mR^X$, Z^2, Z^3, Z^4, Z^5, and Z^6 are as defined generally above and in classes and subclasses herein.

[0072] As described generally above, R^1 is Q-Ar^1. Certain exemplary substituents for R^1 include optionally substituted groups selected from phenyl, cyclohexyl, cyclopentyl, pyridyl, morpholino, piperazinyl, or piperidinyl. In other exemplary embodiments, R^1 is an optionally substituted group selected from phenyl, cyclohexyl, or pyridyl. In yet other embodiments, R^1 is optionally substituted phenyl.

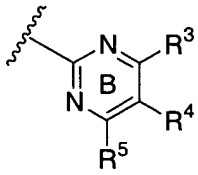
[0073] As described generally above, in certain embodiments, Ar^1 is substituted with q independent occurrences of ZR^Z, where q is 0-5. In certain embodiments, q is 0, 1, 2, or 3 and each independent occurrence of ZR^Z is C_{1-4}alkyl, $N(R')_2$, OR', SR', $CON(R')_2$, NR'COR', $NR'SO_2R'$, or $SO_2N(R')_2$. In yet other embodiments, q is 1 and ZR^Z is $-NH_2$, -OH, C_{1-4}alkoxy, or $-S(O)_2NH_2$. In still other embodiments, q is 1, and ZR^Z is in the meta position and ZR^Z is $-NH_2$, -OH, C_{1-4}alkoxy, or $-S(O)_2NH_2$.

[0074] Exemplary $(T)_mR^X$ and $(U)_nR^Y$ groups of formula **I,** and classes and subclasses thereof as described herein, are hydrogen, halogen, NO_2, CN, OR, SR or $N(R)_2$, or C_{1-4}aliphatic optionally substituted with oxo, OR, SR, $N(R)_2$, halogen, NO_2 or CN. In some embodiments $(T)_mR^X$ and $(U)_nR^Y$ groups are hydrogen, Me, OH, OMe or $N(R)_2$. In other embodiments, $(T)_mR^X$ and $(U)_nR^Y$ are each hydrogen.

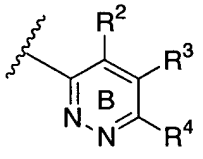
[0075] In certain other preferred embodiments, ring B is one of the rings **i-xiv** depicted below.



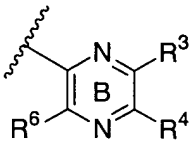
i



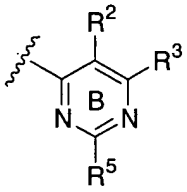
ii



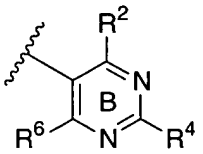
iii



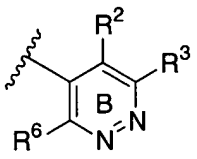
iv



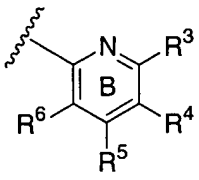
v



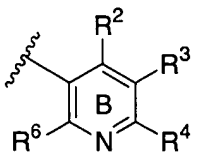
vi



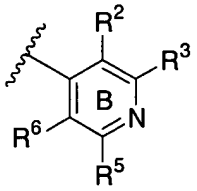
vii



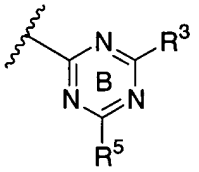
viii



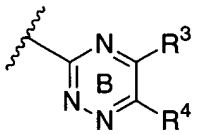
ix



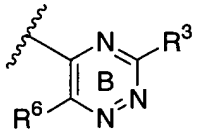
x



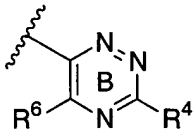
xi



xii



xiii



xiv

[0076] As detailed above, compounds of the invention relate to those compounds where at least one of Z^3, Z^4, or Z^5 is CR^3, CR^4, or CR^5 respectively, and at least one of R^3, R^4, or R^5 is $NRCOR^7$, $CONR(R^7)$, $SO_2NR(R^7)$, $NRSO_2R^7$, $NRCONR(R^7)$, $NRSO_2NR(R^7)$, or $CONRNR(R^7)$, wherein R^7 is $(CH_2)_t$-Y-R^8, wherein t is 0, 1 or 2, wherein Y is a bond or is O, S, NR^9, -OCH_2-, -SCH_2, -NR^9CH_2, $O(CH_2)_2$-, -$S(CH_2)_2$, or –$NR^9(CH_2)_2$, and wherein R^8 is Ar^2, or R^8 and R^9, taken together with the nitrogen atom, form a 5-8 membered heterocyclyl or heteroaryl ring having 1-3 heteroatoms independently selected from nitrogen, oxygen or sulfur.

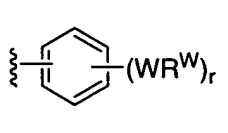
[0077] In certain embodiments, t is 0, Y is a bond, and R^8 is an optionally substituted aryl or heteroaryl moiety. In other embodiments, t is 0, Y is a bond, and R^8 is an optionally substituted heteroaryl moiety.

[0078] In yet other embodiments, R^7 is –CH_2-Y-R^8, and Y is NR^9, O or S, and R^8 is an optionally substituted aryl or heteroaryl moiety. In still other embodiments, R^8 is an optionally substituted aryl moiety.

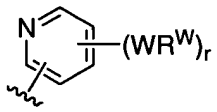
[0079] In yet other embodiments, t is 0 or 1, Y is NR^9, and R^8 and R^9, taken together with the nitrogen atom, form a 5-8 membered heterocyclyl or heteroaryl ring having 1-3 heteroatoms independently selected from nitrogen, oxygen or sulfur.

[0080] In still other embodiments, t is 0 or 1, Y is NR^9, O, $-NR^9CH_2$, $-OCH_2-$, $-NR^9(CH_2)_2-$, or $-O(CH_2)_2-$ and R^8 is an optionally substituted 5-7 membered saturated, partially unsaturated, or fully unsaturated monocyclic ring having 0-3 heteroatoms independently selected from nitrogen, oxygen, or sulfur, or an 8-12 membered saturated, partially unsaturated, or fully unsaturated bicyclic ring system having 0-5 heteroatoms independently selected from nitrogen, oxygen, or sulfur.

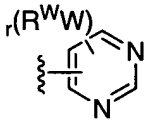
[0081] Certain exemplary R^8 groups include 5- or 6-membered aryl or heteroaryl groups having one of the formulae:



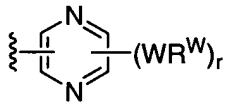
a



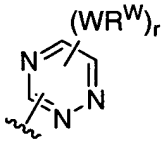
b



c



d



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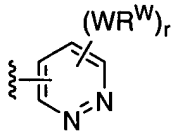

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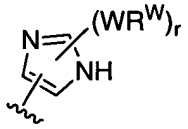

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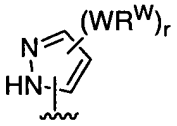

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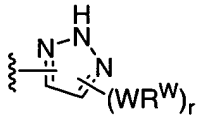
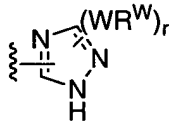


i



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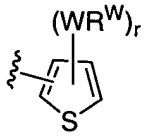

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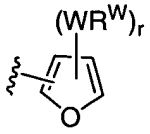

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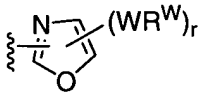
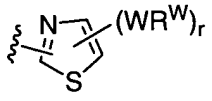


m



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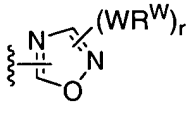
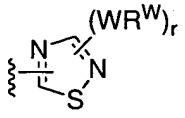
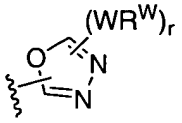
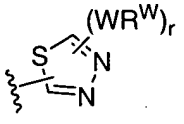


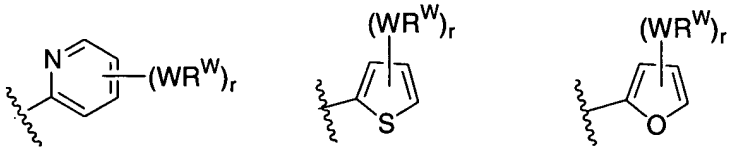






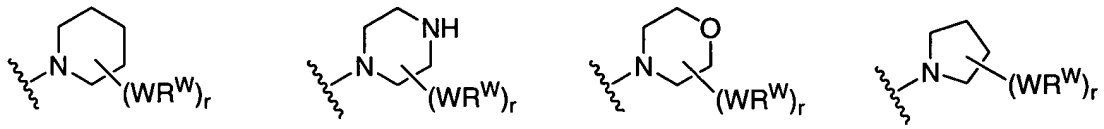
o **p** **q** **r**

[0082] In yet other embodiments, R^8 is a 5- or 6-membered heteroaryl group selected from:



b-i **k-i** **l-i**

[0083] Certain exemplary groups where R^8 and R^9, taken together with the nitrogen atom, form a 5-8 membered heterocyclyl or heteroaryl ring having 1-3 heteroatoms independently selected from nitrogen, oxygen or sulfur, include groups selected from:



s **t** **u** **v**

[0084] In certain embodiments for each of the substituents described generally above, r is 0, 1, 2, or 3. In other embodiments, r is 0, 1, or 2. In still other embodiments, r is 0 or 1.

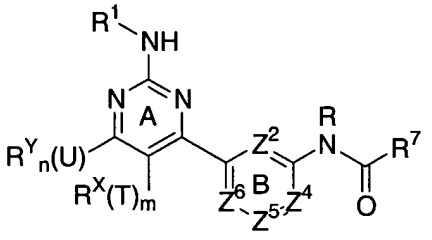
[0085] In certain embodiments, WR^W substituents are halogen, C_{1-4}alkyl, $-(R)_2$, -OR, -SR, $-SO_2N(R)_2$, $-N(R)SO_2R$, -N(R)COR, $-N(R)_2$, $-CH_2OR$, $-CH_2N(R)_2$, or $-CH_2SR$.

[0086] In certain embodiments, when t is 0 and Y is a bond, then R^8 is an optionally substituted heteroaryl moiety selected from one of groups **b** through **r**. In other embodiments, R^8 is an optionally substituted heteroaryl group **b-i**, **k-i**, or **l-i**.

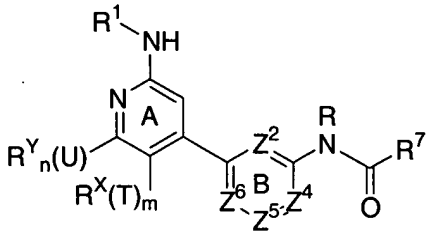
[0087] In yet other embodiments, when t is 1, and Y is O, S or NR^9, then R^8 is optionally substituted phenyl.

[0088] In still other embodiments, when t is 0 or 1, and Y is NR^9, and R^8 and R^9, taken together form an optionally substituted group selected from **s**, **u** or **v**. In yet other embodiments, R^8 and R^9, taken together, form an optionally substituted group **s** or **v**. In other embodiments, R^8 and R^9, taken together form a group **s** or **v**, which group is substituted with one occurrence of -OH, or- CH_2OH.

[0089] It will be appreciated that for compounds as described above, certain additional compounds are of special interest. For example, in certain exemplary embodiments, for compounds of general formula **IA** above, one class of compounds of special interest includes those compounds where Z^3 or Z^5 is CR^3 or CR^5, respectively, and R^3 or R^5 is $NRC(O)R^7$, wherein R^7 is $(CH_2)_t$-Y-R^8, wherein t is 0, 1 or 2, wherein Y is a bond or is O, S, NR^9, -OCH_2-, -SCH_2, -NR^9CH_2, $O(CH_2)_2$-, -$S(CH_2)_2$, or –$NR^9(CH_2)_2$, and wherein R^8 is Ar^2, or R^8 and R^9, taken together with the nitrogen atom, form a 5-8 membered heterocyclyl or heteroaryl ring having 1-3 heteroatoms independently selected from nitrogen, oxygen or sulfur. It will be appreciated that compounds substituted at R^3 and R^5 are equivalent and thus only compounds substituted at R^3 are depicted below by formulas **II-A** and **III-A.**

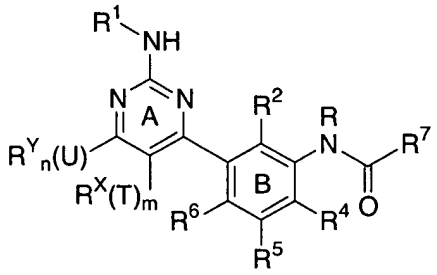


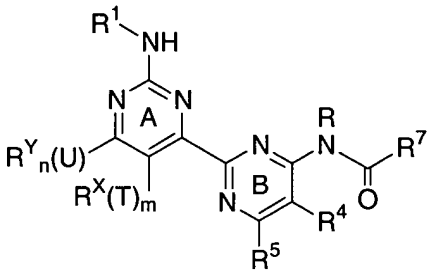
II-A



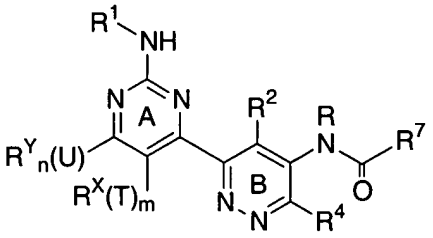
III-A

[0090] It will be appreciated that for each of the compounds depicted by formulas **II-A** ring B is selected from a variety of aryl and heteroaryl groups. In certain, ring B is selected from **i, ii, iii, iv, v, vii, viii, ix, x, xi, xii,** or **xiii** and thus compounds of formulas **II-A-i, II-A-ii, II-A-iii, II-A-iv, II-A-v, II-A-vii, II-A-viii, II-A-ix, II-A-x, II-A-xi, II-A-xii,** or **II-A-xiii** are provided as depicted below:

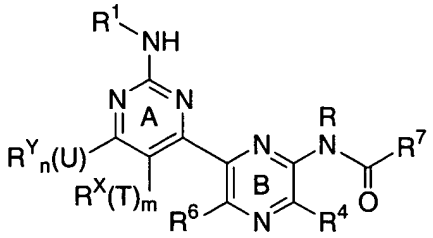




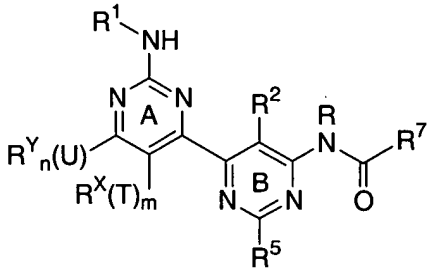
II-A-i



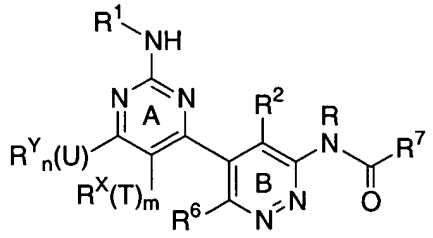
II-A-ii



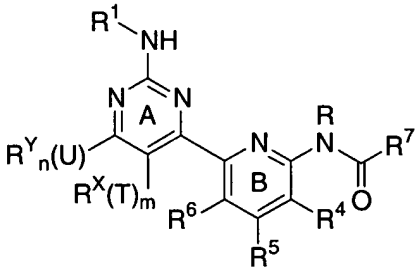
II-A-iii



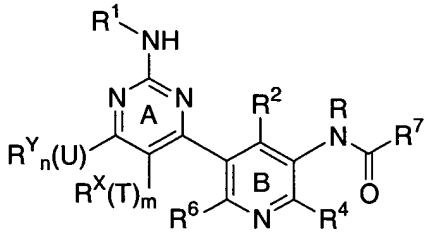
II-A-iv



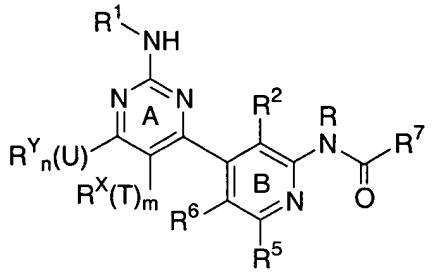
II-A-v



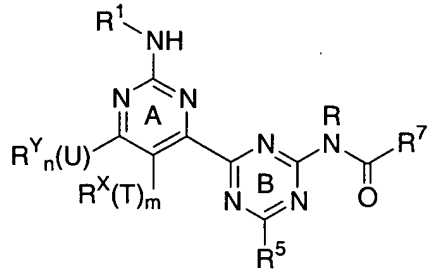
II-A-vii



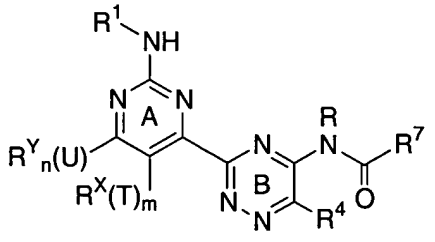
II-A-viii



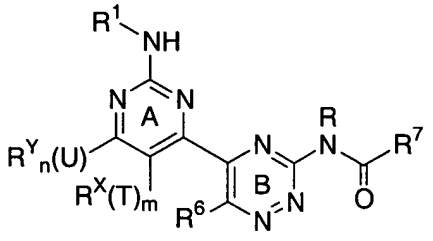
II-A-ix



II-A-x



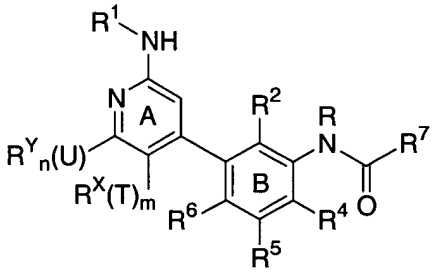
II-A-xi



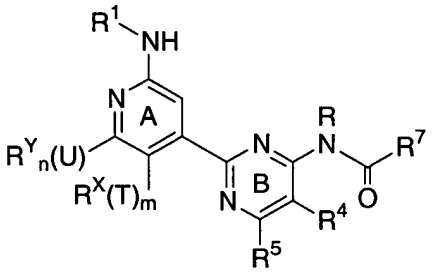
II-A-xii

II-A-xiii

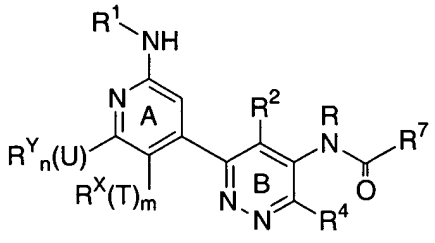
[0091] It will be appreciated that for each of the compounds depicted by formulas **III-A** ring B is selected from a variety of aryl and heteroaryl groups. In certain embodiments, ring B is selected from **i, ii, iii, iv, v, vii, viii, ix, x, xi, xii,** or **xiii** and thus compounds of formulas **III-A-i, III-A-ii, III-A-iii, III-A-iv, III-A-v, III-A-vii, III-A-viii, III-A-ix, III-A-x, III-A-xi, III-A-xii,** or **III-A-xiii** are provided as depicted below:



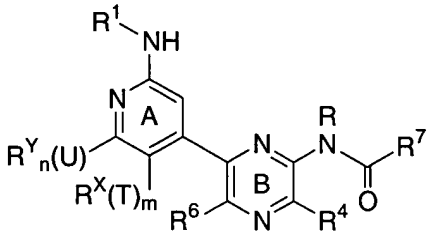
III-A-i



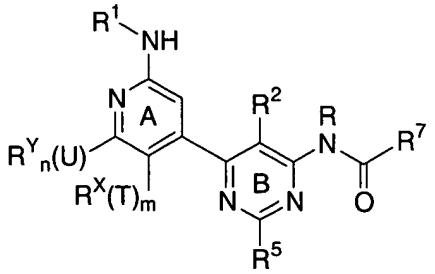
III-A-ii



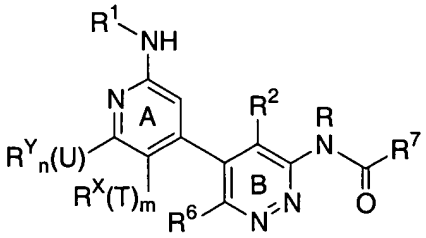
III-A-iii



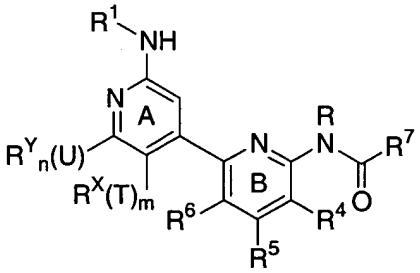
III-A-iv



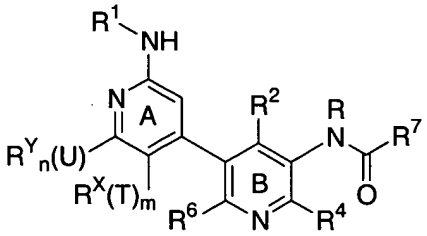
III-A-v



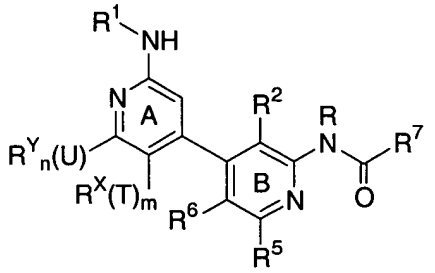
III-A-vii



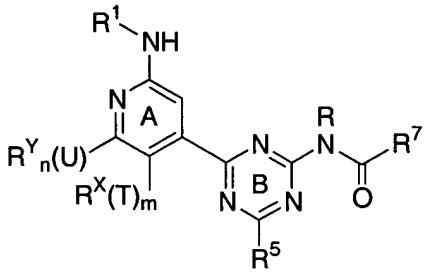
III-A-viii



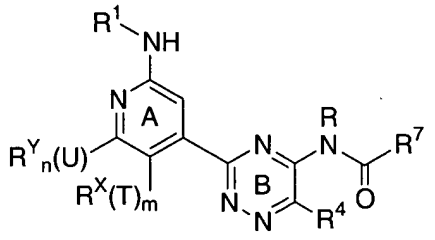
III-A-ix



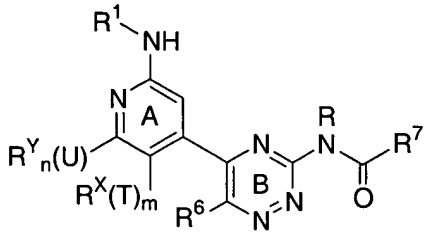
III-A-x



III-A-xi

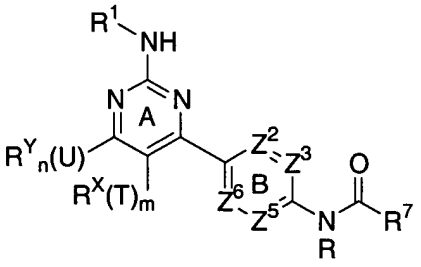


III-A-xii

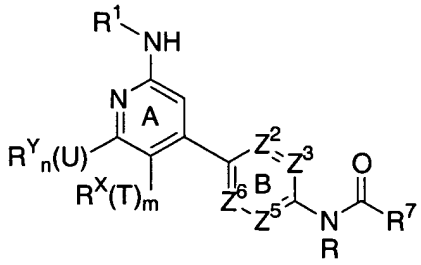


III-A-xiii

[0092] Another class of compounds of special interest includes those compounds where Z^4 is CR^4, and R^4 is $-NRC(O)R^7$, wherein R^7 is $(CH_2)_t$-Y-R^8, wherein t is 0, 1 or 2, wherein Y is a bond or is O, S, NR^9, $-OCH_2-$, $-SCH_2$, $-NR^9CH_2$, $O(CH_2)_2-$, $-S(CH_2)_2$, or $-NR^9(CH_2)_2$, and wherein R^8 is Ar^2, or R^8 and R^9, taken together with the nitrogen atom, form a 5-8 membered heterocyclyl or heteroaryl ring having 1-3 heteroatoms independently selected from nitrogen, oxygen or sulfur.

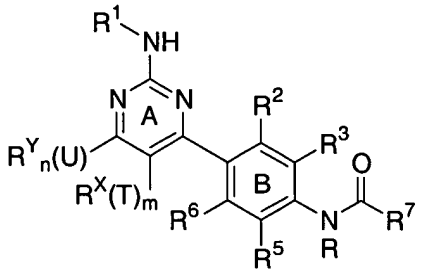


II-B

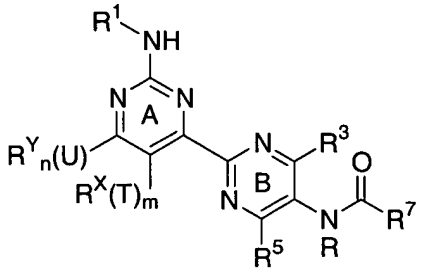


III-B

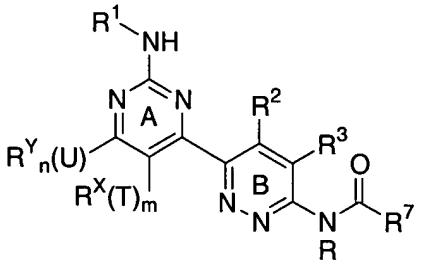
[0093] It will be appreciated that for each of the compounds depicted by formulas **II-B** ring B is selected from a variety of aryl and heteroaryl groups. In certain embodiments, ring B is selected from **i, ii, iii, iv, vi, viii, ix, xii,** or **xiv** and thus compounds of formulas **II-B-i**, **II-B-ii, II-B-iii, II-B-iv, II-B-vi, II-B-viii, II-B-ix, II-B-xii,** or **II-B-xiv** are provided as depicted below:



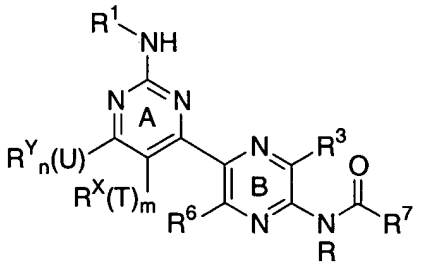
II-B-i



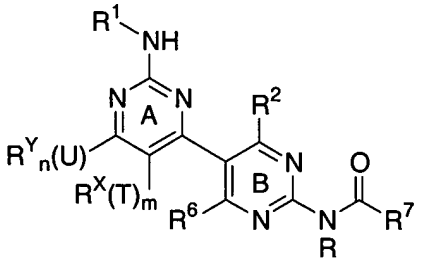
II-B-ii



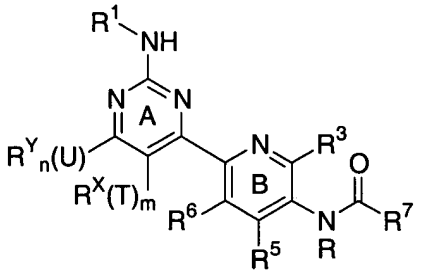
II-B-iii



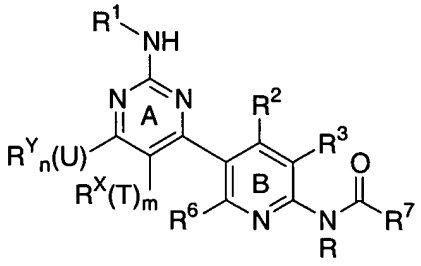
II-B-iv



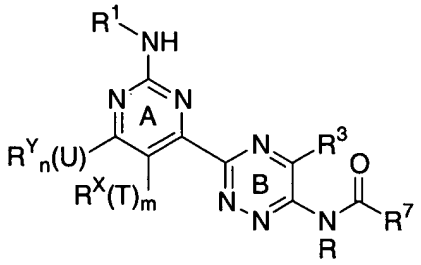
II-B-vi



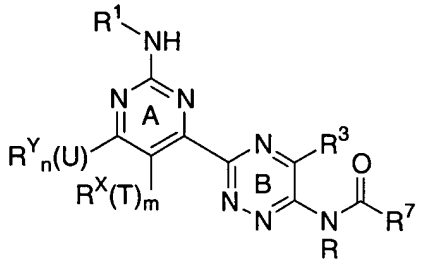
II-B-viii



II-B-ix

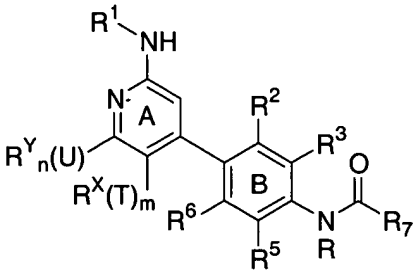


II-B-xii

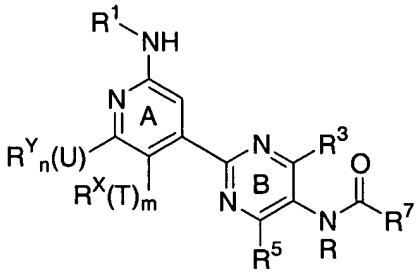


II-B-xiv

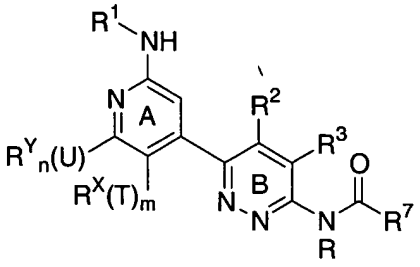
[0094] It will be appreciated that for each of the compounds depicted by formulas **III-B** ring B is selected from a variety of aryl and heteroaryl groups. In certain embodiments, ring B is selected from **i, ii, iii, iv, vi, viii, ix, xii,** or **xiv** and thus compounds of formulas **III-B-i**, **III-B-ii, III-B-iii, III-B-iv, III-B-vi, III-B-viii, III-B-ix, III-B-xii,** or **III-B-xiv** are provided as depicted below:



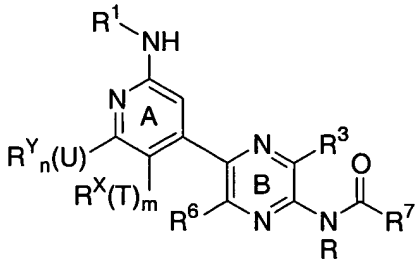
III-B-i



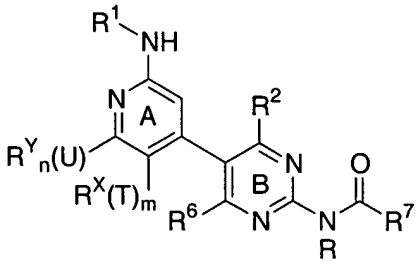
III-B-ii



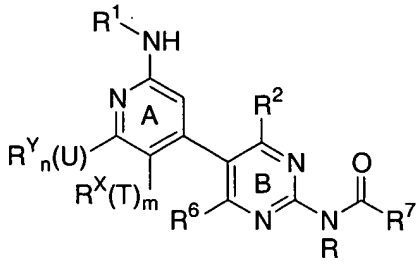
III-B-iii



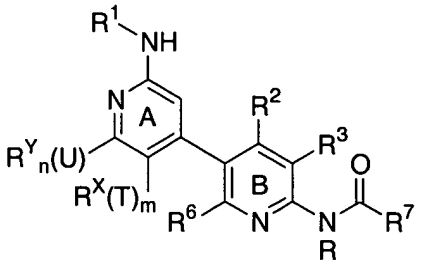
III-B-iv



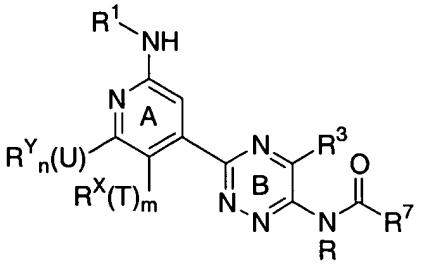
III-B-vi



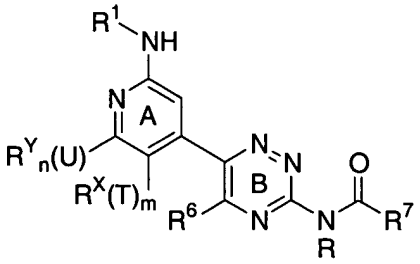
III-B-viii



III-B-ix

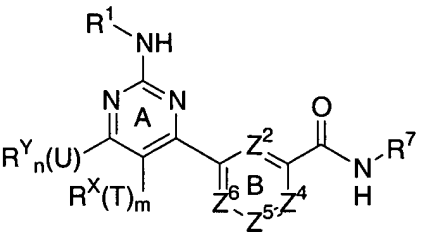


III-B-xii

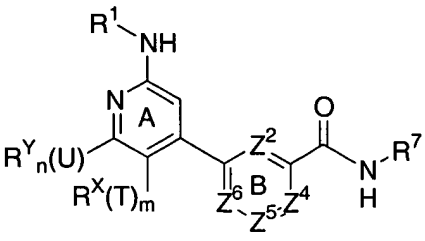


III-B-xiv

[0095] Yet another class of compounds of special interest includes those compounds where Z^3 or Z^5 is CR^3 or CR^5, respectively, and R^3 or R^5 is $C(O)N(R)(R^7)$, wherein R^7 is $(CH_2)_t$-Y-R^8, wherein t is 0, 1 or 2, wherein Y is a bond or is O, S, NR^9, -OCH_2-, -SCH_2, -NR^9CH_2, $O(CH_2)_2$-, -$S(CH_2)_2$, or –$NR^9(CH_2)_2$, and wherein R^8 is Ar^2, or R^8 and R^9, taken together with the nitrogen atom, form a 5-8 membered heterocyclyl or heteroaryl ring having 1-3 heteroatoms independently selected from nitrogen, oxygen or sulfur. It will be appreciated that because of symmetry considerations, compounds substituted at R^3 and R^5 are equivalent and thus only compounds substituted at R^3 are depicted below by formulas **II-C** and **III-C.**



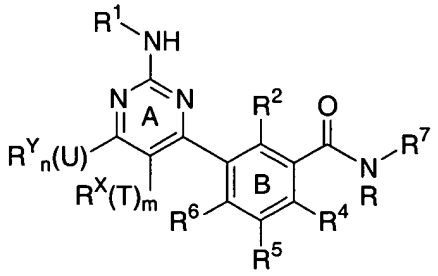
II-C



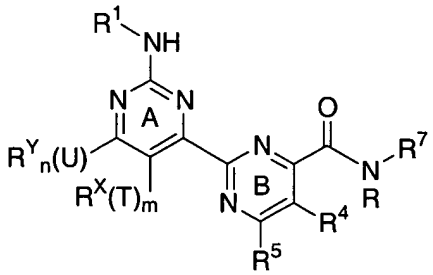
III-C

[0096] It will be appreciated that for each of the compounds depicted by formulas **II-C** ring B is selected from a variety of aryl and heteroaryl groups. In certain embodiments, ring B is

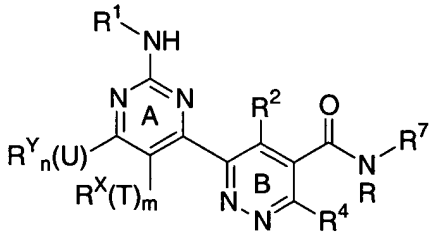
selected from **i, ii, iii, iv, v, vii, viii, ix, x, xi, xii,** or **xiii** and thus compounds of formulas **II-C-i, II-C-ii, II-C-iii, II-C-iv, II-C-v, II-C-vii, II-C-viii, II-C-ix, II-C-x, II-C-xi, II-C-xii,** or **II-C-xiii** are provided as depicted below:



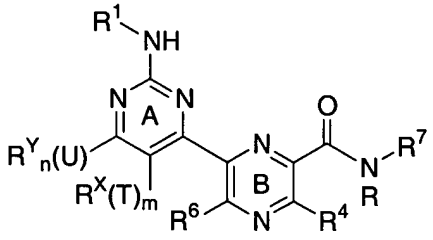
II-C-i



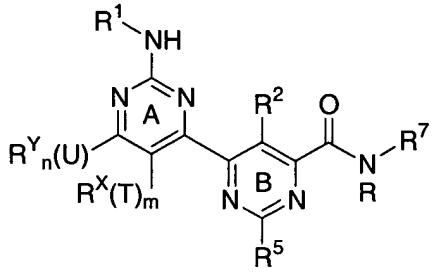
II-C-ii



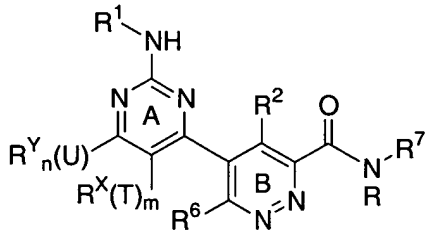
II-C-iii



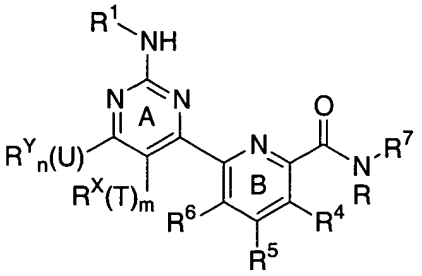
II-C-iv



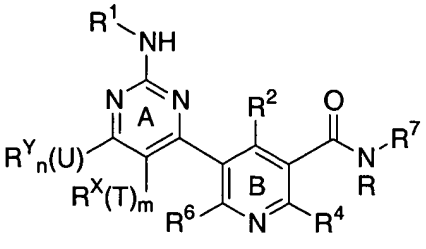
II-C-v



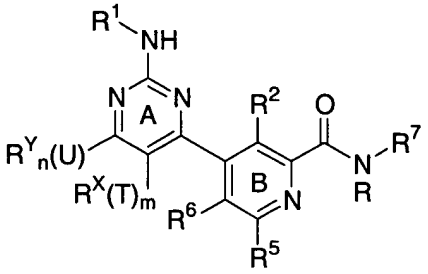
II-C-vii



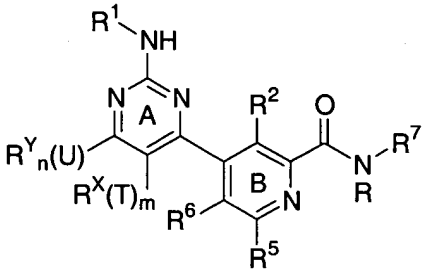
II-C-viii



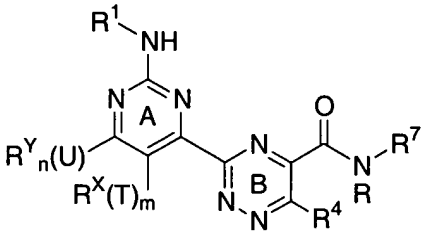
II-C-ix



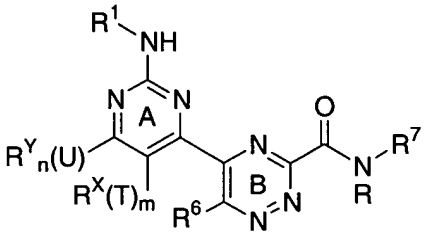
II-C-x



II-C-xi

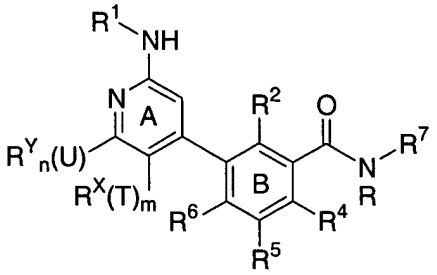


II-C-xii

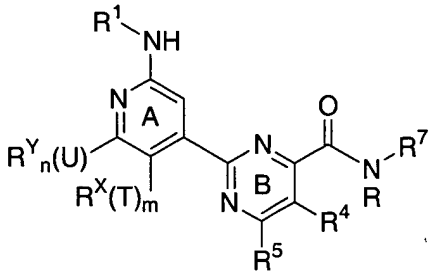


II-C-xiii

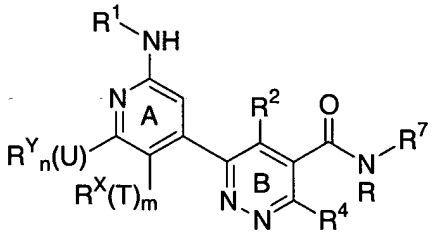
[0097] It will be appreciated that for each of the compounds depicted by formulas **III-C** ring B is selected from a variety of aryl and heteroaryl groups. In certain embodiments, ring B is selected from **i, ii, iii, iv, v, vii, viii, ix, x, xi, xii,** or **xiii** and thus compounds of formulas **III-C-i, III-C-ii, III-C-iii, III-C-iv, III-C-v, III-C-vii, III-C-viii, III-C-ix, III-C-x, III-C-xi, III-C-xii,** or **III-C-xiii** are provided as depicted below:



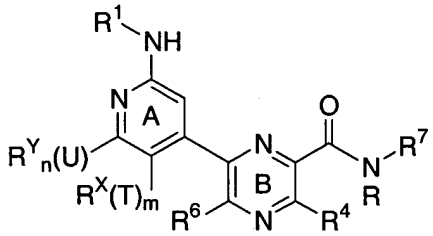
III-C-i



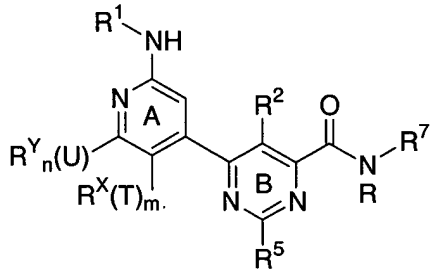
III-C-ii



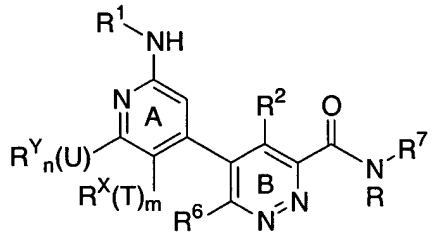
III-C-iii



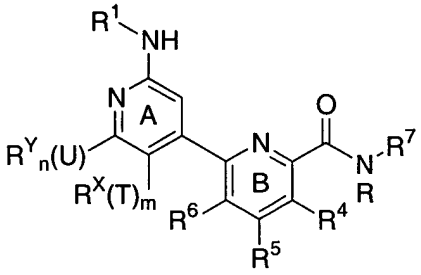
III-C-iv



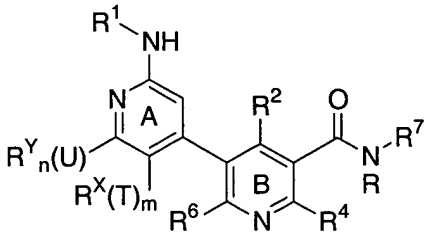
III-C-v



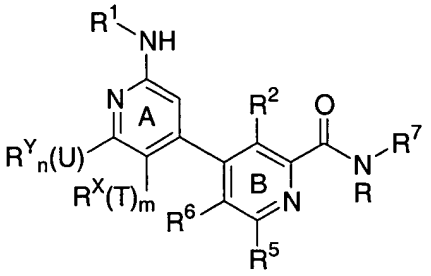
III-C-vii



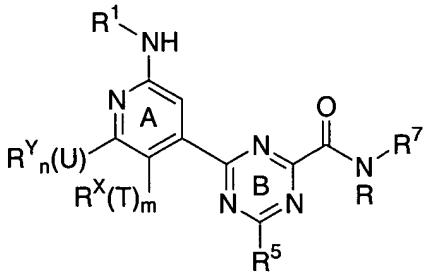
III-C-viii



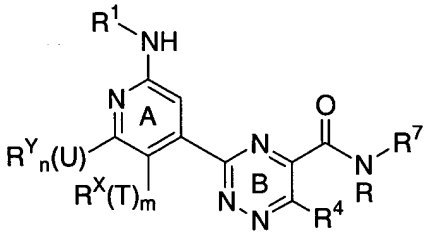
III-C-ix



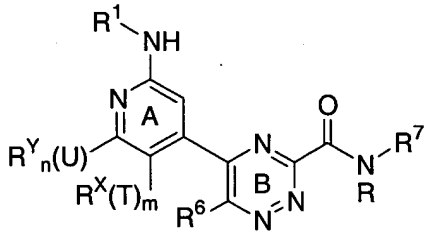
III-C-x



III-C-xi

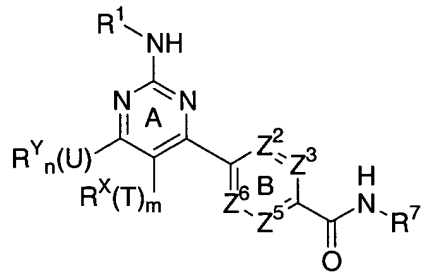


III-C-xii

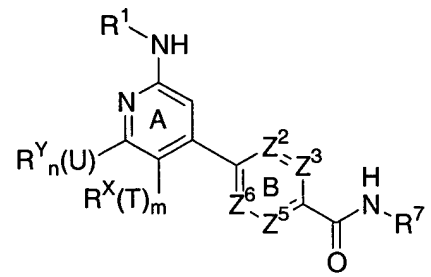


III-C-xiii

[0098] Another class of compounds of special interest includes those compounds where Z^4 is CR^4, and R^4 is $C(O)N(R)(R^7)$, wherein R^7 is $(CH_2)_t$-Y-R^8, wherein t is 0, 1 or 2, wherein Y is a bond or is O, S, NR^9, -OCH_2-, -SCH_2, -NR^9CH_2, $O(CH_2)_2$-, -$S(CH_2)_2$, or –$NR^9(CH_2)_2$, and wherein R^8 is Ar^2, or R^8 and R^9, taken together with the nitrogen atom, form a 5-8 membered heterocyclyl or heteroaryl ring having 1-3 heteroatoms independently selected from nitrogen, oxygen or sulfur.

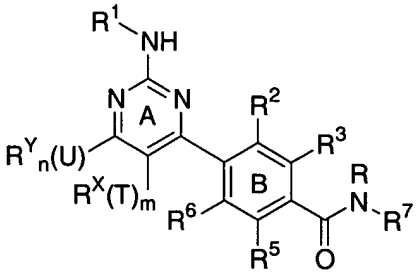


II-D

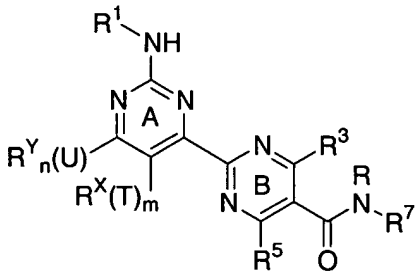


III-D

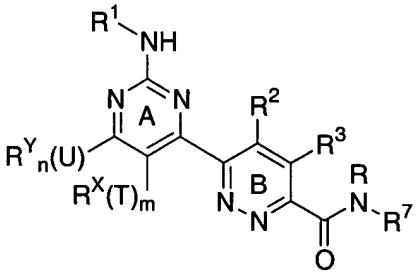
[0099] It will be appreciated that for each of the compounds depicted by formulas **II-D** ring B is selected from a variety of aryl and heteroaryl groups. In certain embodiments, ring B is selected from **i, ii, iii, iv, vi, viii, ix, xii,** or **xiv** and thus compounds of formulas **II-D-i, II-D-ii, II-D-iii, II-D-iv, II-D-vi, II-D-viii, II-D-ix, II-D-xii,** or **II-D-xiv** are provided as depicted below:



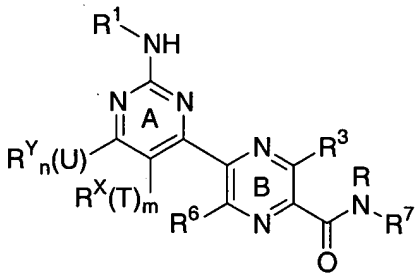
II-D-i



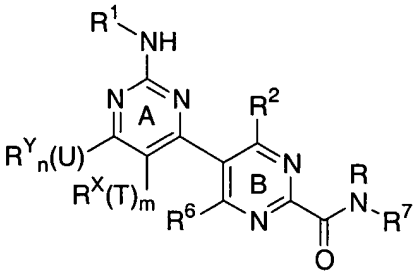
II-D-ii



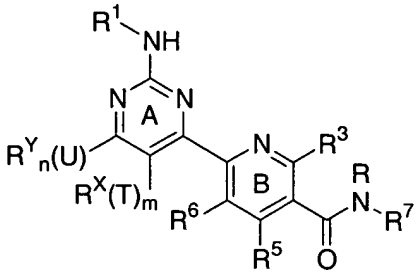
II-D-iii



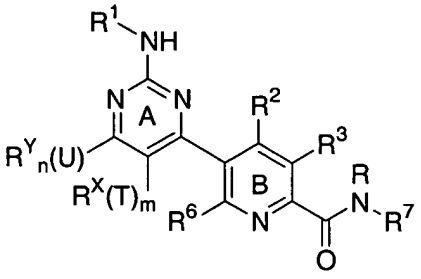
II-D-iv



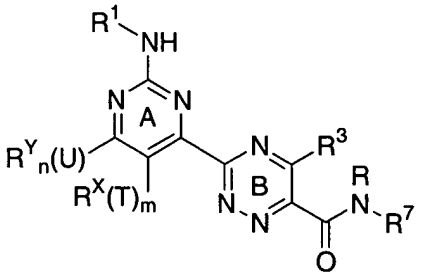
II-D-vi



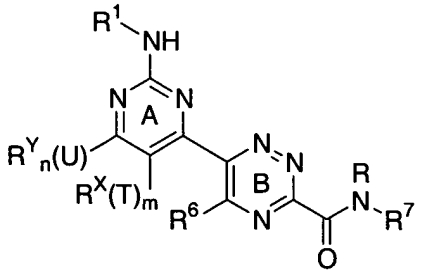
II-D-viii



II-D-ix

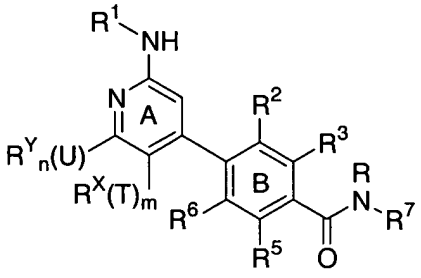


II-D-xii

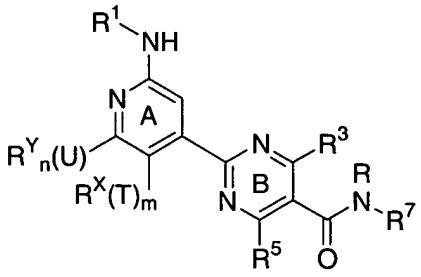


II-D-xiv

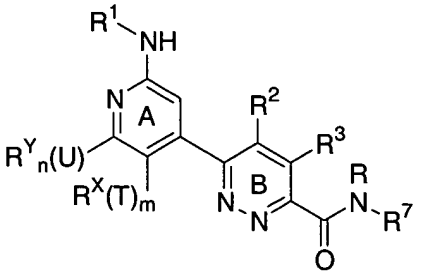
[00100] It will be appreciated that for each of the compounds depicted by formulas **III-D** ring B is selected from a variety of aryl and heteroaryl groups. In certain embodiments, ring B is selected from **i, ii, iii, iv, vi, viii, ix, xii,** or **xiv** and thus compounds of formulas **III-D-i**, **III-D-ii, III-D-iii, III-D-iv, III-D-vi, III-D-viii, III-D-ix, III-D-xii,** or **III-D-xiv** are provided as depicted below:



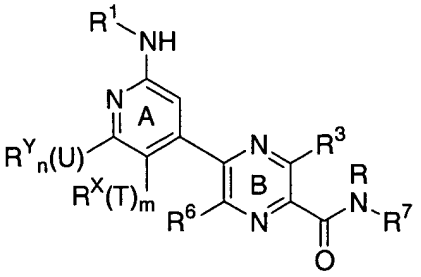
III-D-i



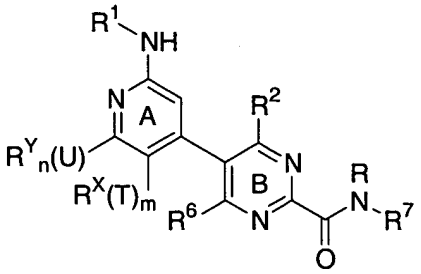
III-D-ii



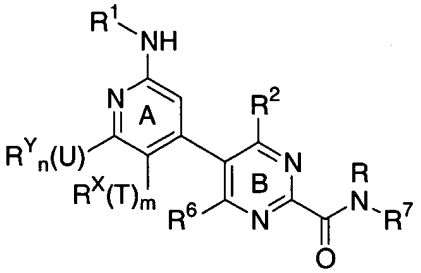
III-D-iii



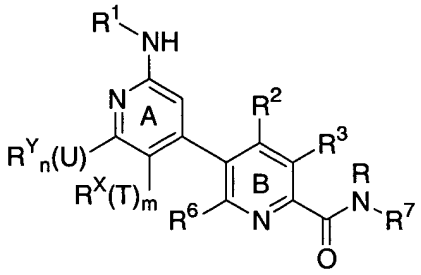
III-D-iv



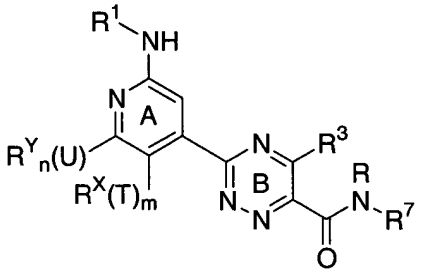
III-D-vi



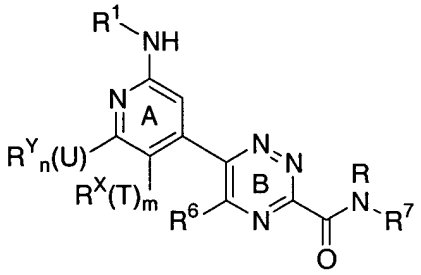
III-D-viii



III-D-ix



III-D-xii



III-D-xiv

[00101] Certain subclasses of the foregoing compounds are described in more detail below. It will be appreciated that, for each of the compounds generally described above (formula **I**) and classes thereof, (e.g., formulas **I, II-A, III-A, II-B, III-B, II-C, III-C, II-D, or III-D** and subsets thereof (e.g., **II-A-i**)), any combination of the subsets set forth below may be utilized to describe exemplary subclasses of the invention. In particular, certain exemplary subsets include, but are not limited to the following:

[00102] i) compounds where R^1 is an optionally substituted phenyl, cyclohexyl, cyclopentyl, pyridyl, morpholino, piperazinyl, or piperidinyl group;

[00103] ii) compounds where R^1 is an optionally substituted phenyl, cyclohexyl, or pyridyl group;

[00104] iii) compounds where R^1 is optionally substituted phenyl;

[00105] iv) compounds where Ar^1 is substituted with q independent occurrences of ZR^Z, where q is 0-5, and each independent occurrence of ZR^Z is C_{1-4}alkyl, $N(R')_2$, OR', SR', $CON(R')_2$, NR'COR', $NR'SO_2R'$, or $SO_2N(R')_2$;

[00106] v) compounds where q is 1 and ZR^Z is $-NH_2$, -OH, C_{1-4}alkoxy, or $-SO_2NH_2$;

[00107] vi) compounds where q is 1, and ZR^Z is in the meta position and ZR^Z is $-NH_2$, -OH, C_{1-4}alkoxy, or $-SO_2NH_2$;

[00108] vii) compounds where $(T)_mR^X$ and $(U)_nR^Y$ are hydrogen, halogen, NO_2, CN, OR, SR or $N(R)_2$, or C_{1-4}aliphatic optionally substituted with oxo, OR, SR, $N(R)_2$, halogen, NO_2 or CN;

[00109] viii) compounds where $(T)_mR^X$ and $(U)_nR^Y$ groups are hydrogen, Me, OH, OMe or $N(R)_2$;

[00110] ix) compounds where $(T)_mR^X$ and $(U)_nR^Y$ are each hydrogen;

[00111] x) compounds where t is 0, Y is a bond, and R^8 is an optionally substituted aryl or heteroaryl moiety;

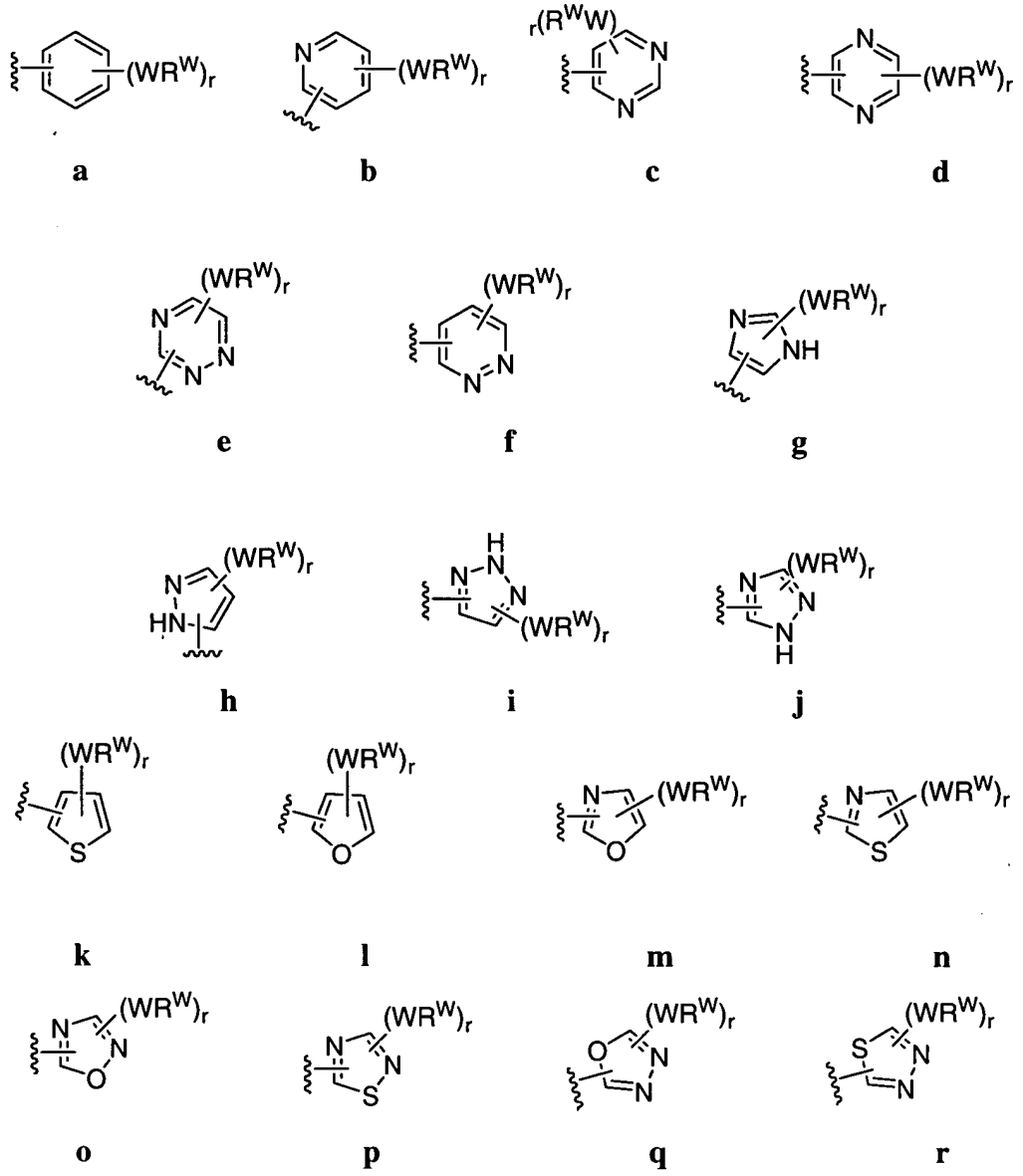
[00112] xi) compounds where t is 0, Y is a bond, and R^8 is an optionally substituted heteroaryl moiety;

[00113] xii) compounds where R^7 is $-CH_2$-Y-R^8, and Y is NR^9, O or S, and R^8 is an optionally substituted aryl or heteroaryl moiety;

[00114] xiii) compounds where R^8 is an optionally substituted aryl moiety.

[00115] xiv) compounds where t is 0 or 1, Y is NR^9, and R^8 and R^9, taken together with the nitrogen atom, form an optionally substituted 5-8 membered heterocyclyl or heteroaryl ring having 1-3 heteroatoms independently selected from nitrogen, oxygen or sulfur;

[00116] xv) compounds where R^8 is a 5- or 6-membered aryl or heteroaryl group having one of the formulae:



a **b** **c** **d**

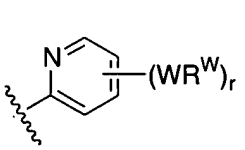
e **f** **g**

h **i** **j**

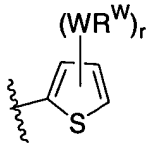
k **l** **m** **n**

o **p** **q** **r**

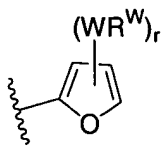
[00117] xvi) compounds where R^8 is a 5- or 6-membered heteroaryl group selected from:



b-i

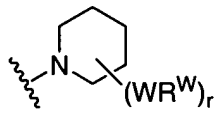


k-i

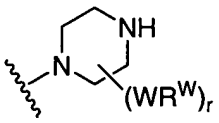


l-i

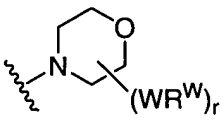
[00118] xvii) compounds where R^8 and R^9, taken together with the nitrogen atom, form a group selected from:



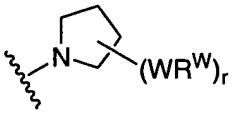
s



t



u



v

[00119] xviii) compounds where r is 0, 1, 2, or 3;

[00120] xix) compounds where r is 0, 1, or 2;

[00121] xx) compounds where r is 0 or 1;

[00122] xxi) compounds where WR^W substituents are halogen, $C_{1\text{-}4}$alkyl, $-(R)_2$, -OR, -SR, $-SO_2N(R)_2$, $-N(R)SO_2R$, -N(R)COR, $-N(R)_2$, $-CH_2OR$, $-CH_2N(R)_2$, or $-CH_2SR$;

[00123] xxii) compounds where t is 0, Y is a bond, and R^8 is an optionally substituted heteroaryl moiety selected from one of groups **b** through **r**;

[00124] xxiii) compounds where t is 0, Y is a bond, and R^8 is an optionally substituted heteroaryl group **b-i**, **k-i**, or **l-i**;

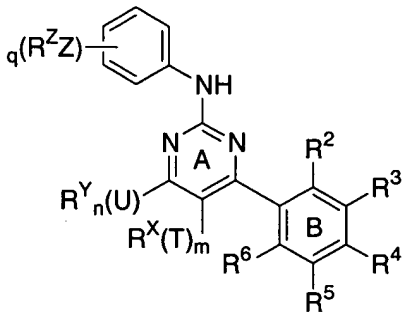
[00125] xxiv) compounds where t is 1, and Y is O, S or NR^9, then R^8 is optionally substituted phenyl;

[00126] xxv) compounds where t is 0 or 1, Y is NR^9, and R^8 and R^9, taken together form an optionally substituted group selected from **s**, **u** or **v**;

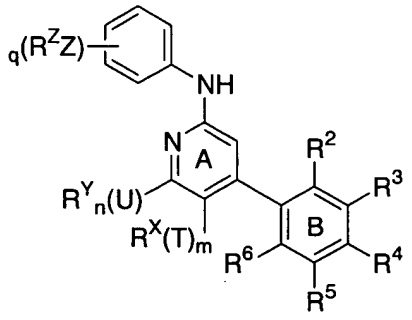
[00127] xxvi) compounds where R^8 and R^9, taken together, form an optionally substituted group **s** or **v**;

[00128] xxvii) compounds where R^8 and R^9, taken together form a group **s** or **v**, which group is substituted with one occurrence of OH, or CH_2OH.

[00129] Certain other exemplary embodiments relate to those compounds where R^1 is optionally substituted phenyl and ring B is an optionally substituted phenyl group and compounds have one of the general formulae **IV** or **V:**

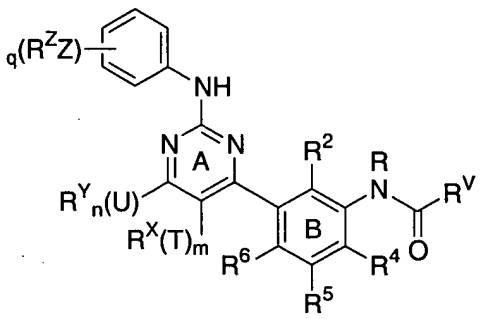


IV

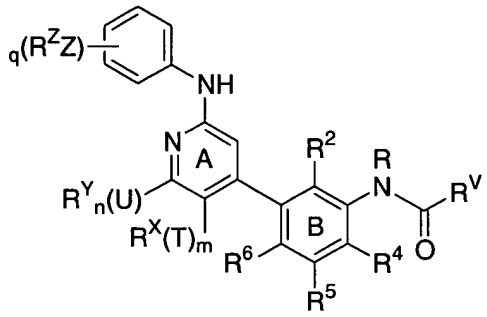


V

[00130] In certain embodiments, for compounds described directly above, R^3 is $NRCOR^7$ and compounds have one of the general formulae **IV-A-(i)** or **V-A-(i):**

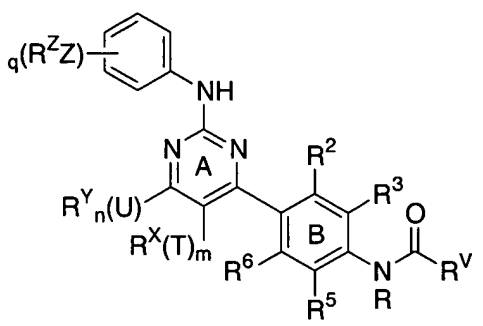


IV-A-(i)

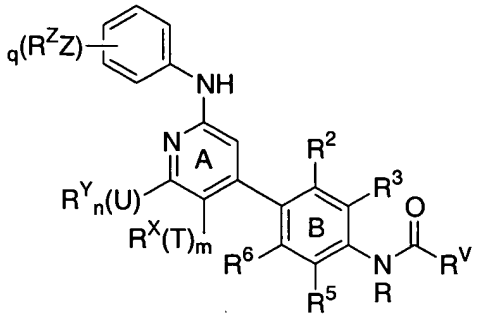


V-A-(i)

[00131] In certain other embodiments, for compounds described directly above, R^4 is $NRCOR^7$ and compounds have one of the general formulae **IV-B-(i)** or **V-B-(i):**

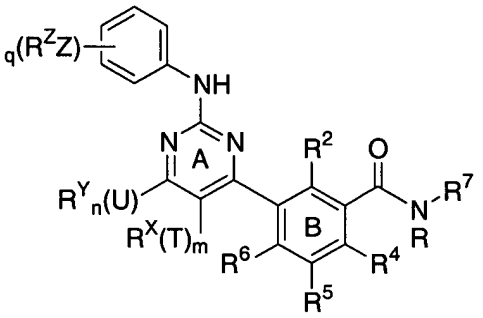


IV-B-(i)

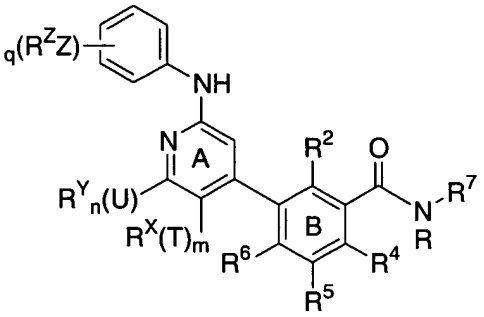


V-B-(i)

[00132] In certain other embodiments, for compounds described directly above, R^3 is $CONRR^7$ and compounds have one of the general formulae **IV-C-(i)** or **V-C-(i):**

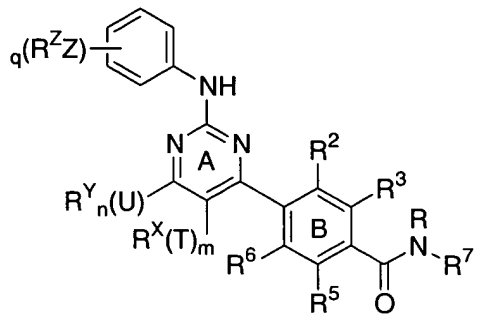


IV-C-(i)

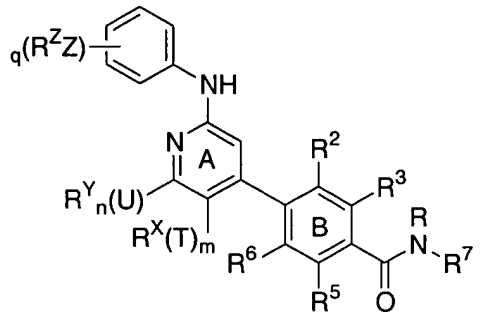


V-C-(i)

[00133] In still other embodiments, for compounds described directly above, R^4 is $CONRR^7$ and compounds have one of the general formulae **IV-D-(i)** or **VII-D-(i):**



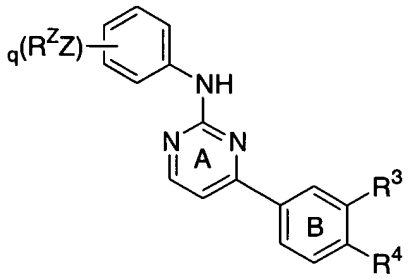
IV-D-(i)



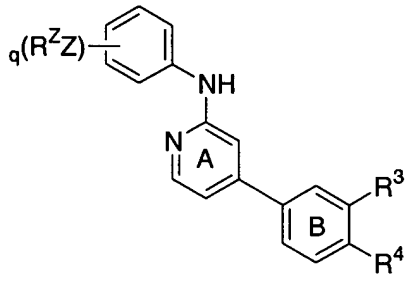
V-D-(i)

[00134] It will be appreciated that each of ZR^Z, q, U, R^Y, T, R^X, n, m, R^2, R^3, R^5, R^6, R and R^7 are each defined generally above and in classes, subclasses and species herein.

[00135] In other embodiments, R^1 is optionally substituted phenyl, ring A is pyrimidinyl or pyridyl, ring B is phenyl, and R^2, R^5, and R^6 are each hydrogen, and R^3 and R^4 are as defined generally and in classes, subclasses and species herein, and compounds have one of the general formulae **VI** or **VII**:



VI



VII

[00136] Certain exemplary subsets for each of the compounds of formulas **IV, V, VI** and **VII** described above include those compounds where:

a. q is 0 or 1 and ZR^Z is $-NH_2$, -OH, C_{1-4}alkoxy, or $-SO_2NH_2$;

b. R^3 is $NRCOR^7$, wherein R^7 is $(CH_2)_t$-Y-R^8, and t is 0, Y is a bond, and R^8 is an optionally substituted heteroaryl moiety selected from one of groups **b** through **r,** and wherein r is 0 or 1, and WR^W substituents are halogen, C_{1-4}alkyl, $-(R)_2$, -OR, -SR, $-SO_2N(R)_2$, $-N(R)SO_2R$, -N(R)COR, $-N(R)_2$, $-CH_2OR$, $-CH_2N(R)_2$, or $-CH_2SR$; and

c. R^4 is hydrogen.

[00137] Certain exemplary subsets for each of the compounds of formulas **IV, V, VI** and **VII** described above include those compounds where:

a. q is 0 or 1 and ZR^Z is $-NH_2$, -OH, C_{1-4}alkoxy, or $-SO_2NH_2$;

b. R^3 is $CONRR^7$, wherein R^7 is $(CH_2)_t$-Y-R^8, and t is 0, Y is a bond, and R^8 is an optionally substituted heteroaryl moiety selected from one of groups **b** through **r,**

and wherein r is 0 or 1, and WR^W substituents are halogen, C_{1-4}alkyl, -$(R)_2$, -OR, -SR, -$SO_2N(R)_2$, -$N(R)SO_2R$, -N(R)COR, -$N(R)_2$, -CH_2OR, -$CH_2N(R)_2$, or -CH_2SR; and

c. R^4 is hydrogen.

[00138] Certain exemplary subsets for each of the compounds of formulas **IV, V, VI** and **VII** described above include those compounds where:

a. q is 0 or 1 and ZR^Z is -NH_2, -OH, C_{1-4}alkoxy, or -SO_2NH_2;

b. R^4 is $NRCOR^7$, wherein R^7 is $(CH_2)_t$-Y-R^8, and t is 0, Y is a bond, and R^8 is an optionally substituted heteroaryl moiety selected from one of groups **b** through **r,** and wherein r is 0 or 1, and WR^W substituents are halogen, C_{1-4}alkyl, -$(R)_2$, -OR, -SR, -$SO_2N(R)_2$, -$N(R)SO_2R$, -N(R)COR, -$N(R)_2$, -CH_2OR, -$CH_2N(R)_2$, or -CH_2SR; and

c. R^3 is hydrogen.

[00139] Certain exemplary subsets for each of the compounds of formulas **IV, V, VI** and **VII** described above include those compounds where:

a. q is 0 or 1 and ZR^Z is -NH_2, -OH, C_{1-4}alkoxy, or -SO_2NH_2;

b. R^4 is $CONRR^7$, wherein R^7 is $(CH_2)_t$-Y-R^8, and t is 0, Y is a bond, and R^8 is an optionally substituted heteroaryl moiety selected from one of groups **b** through **r,** and wherein r is 0 or 1, and WR^W substituents are halogen, C_{1-4}alkyl, -$(R)_2$, -OR, -SR, -$SO_2N(R)_2$, -$N(R)SO_2R$, -N(R)COR, -$N(R)_2$, -CH_2OR, -$CH_2N(R)_2$, or -CH_2SR; and

c. R^3 is hydrogen.

[00140] Certain exemplary subsets for each of the compounds of formulas **IV, V, VI** and **VII** described above include those compounds where:

a. q is 0 or 1 and ZR^Z is -NH_2, -OH, C_{1-4}alkoxy, or -SO_2NH_2;

b. R^3 is $NRCOR^7$, wherein R^7 is $(CH_2)_t$-Y-R^8, and t is 1, Y is O, S or NR^9, and R^8 is an optionally substituted phenyl group, and wherein r is 0 or 1, and WR^W

substituents are halogen, C_{1-4}alkyl, -$(R)_2$, -OR, -SR, -$SO_2N(R)_2$, -$N(R)SO_2R$, -$N(R)COR$, -$N(R)_2$, -CH_2OR, -$CH_2N(R)_2$, or -CH_2SR; and

c. R^4 is hydrogen.

[00141] Certain exemplary subsets for each of the compounds of formulas **IV, V, VI** and **VII** described above include those compounds where:

a. q is 0 or 1 and ZR^Z is -NH_2, -OH, C_{1-4}alkoxy, or -SO_2NH_2;

b. R^3 is $CONRR^7$, wherein R^7 is $(CH_2)_t$-Y-R^8, and t is 1, Y is O, S or NR^9, and R^8 is an optionally substituted phenyl group, and wherein r is 0 or 1, and WR^W substituents are halogen, C_{1-4}alkyl, -$(R)_2$, -OR, -SR, -$SO_2N(R)_2$, -$N(R)SO_2R$, -$N(R)COR$, -$N(R)_2$, -CH_2OR, -$CH_2N(R)_2$, or -CH_2SR; and

c. R^4 is hydrogen.

[00142] Certain exemplary subsets for each of the compounds of formulas **IV, V, VI** and **VII** described above include those compounds where:

a. q is 0 or 1 and ZR^Z is -NH_2, -OH, C_{1-4}alkoxy, or -SO_2NH_2;

b. R^4 is $NRCOR^7$, wherein R^7 is $(CH_2)_t$-Y-R^8, and t is 1, Y is O, S or NR^9, and R^8 is an optionally substituted phenyl group, and wherein r is 0 or 1, and WR^W substituents are halogen, C_{1-4}alkyl, -$(R)_2$, -OR, -SR, -$SO_2N(R)_2$, -$N(R)SO_2R$, -$N(R)COR$, -$N(R)_2$, -CH_2OR, -$CH_2N(R)_2$, or -CH_2SR; and

c. R^3 is hydrogen.

[00143] Certain exemplary subsets for each of the compounds of formulas **IV, V, VI** and **VII** described above include those compounds where:

a. q is 0 or 1 and ZR^Z is -NH_2, -OH, C_{1-4}alkoxy, or -SO_2NH_2;

b. R^4 is $CONRR^7$, wherein R^7 is $(CH_2)_t$-Y-R^8, and t is 1, Y is O, S or NR^9, and R^8 is an optionally substituted phenyl group, and wherein r is 0 or 1, and WR^W substituents are halogen, C_{1-4}alkyl, -$(R)_2$, -OR, -SR, -$SO_2N(R)_2$, -$N(R)SO_2R$, -$N(R)COR$, -$N(R)_2$, -CH_2OR, -$CH_2N(R)_2$, or -CH_2SR; and

c. R^3 is hydrogen.

[00144] Certain exemplary subsets for each of the compounds of formulas **IV, V, VI** and **VII** described above include those compounds where:

a. q is 0 or 1 and ZR^Z is $-NH_2$, -OH, C_{1-4}alkoxy, or $-SO_2NH_2$;

b. R^3 is $NRCOR^7$, wherein R^7 is $(CH_2)_t$-Y-R^8, and t is 0 or 1, Y is NR^9, and R^8 and R^9, taken together with the nitrogen atom, form a group selected from **s**, **t**, **u**, or **v**, and wherein r is 0 or 1, and WR^W substituents are halogen, C_{1-4}alkyl, $-(R)_2$, -OR, -SR, $-SO_2N(R)_2$, $-N(R)SO_2R$, -N(R)COR, $-N(R)_2$, $-CH_2OR$, $-CH_2N(R)_2$, or $-CH_2SR$; and

c. R^4 is hydrogen.

[00145] Certain exemplary subsets for each of the compounds of formulas **IV, V, VI** and **VII** described above include those compounds where:

a. q is 0 or 1 and ZR^Z is $-NH_2$, -OH, C_{1-4}alkoxy, or $-SO_2NH_2$;

b. R^3 is $CONRR^7$, wherein R^7 is $(CH_2)_t$-Y-R^8, and t is 0 or 1, Y is NR^9, and R^8 and R^9, taken together with the nitrogen atom, form a group selected from **s**, **t**, **u**, or **v**, and wherein r is 0 or 1, and WR^W substituents are halogen, C_{1-4}alkyl, $-(R)_2$, -OR, -SR, $-SO_2N(R)_2$, $-N(R)SO_2R$, -N(R)COR, $-N(R)_2$, $-CH_2OR$, $-CH_2N(R)_2$, or $-CH_2SR$; and

c. R^4 is hydrogen.

[00146] Certain exemplary subsets for each of the compounds of formulas **IV, V, VI** and **VII** described above include those compounds where:

a. q is 0 or 1 and ZR^Z is $-NH_2$, -OH, C_{1-4}alkoxy, or $-SO_2NH_2$;

b. R^4 is $NRCOR^7$, wherein R^7 is $(CH_2)_t$-Y-R^8, and t is 0 or 1, Y is NR^9, and R^8 and R^9, taken together with the nitrogen atom, form a group selected from **s**, **t**, **u**, or **v**, and wherein r is 0 or 1, and WR^W substituents are halogen, C_{1-4}alkyl, $-(R)_2$, -OR, -SR, $-SO_2N(R)_2$, $-N(R)SO_2R$, -N(R)COR, $-N(R)_2$, $-CH_2OR$, $-CH_2N(R)_2$, or $-CH_2SR$; and

c. R^3 is hydrogen.

[00147] Certain exemplary subsets for each of the compounds of formulas **IV, V, VI** and **VII** described above include those compounds where:

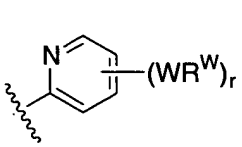
a. q is 0 or 1 and ZR^Z is $-NH_2$, -OH, C_{1-4}alkoxy, or $-SO_2NH_2$;

b. R^4 is $CONRR^7$, wherein R^7 is $(CH_2)_t$-Y-R^8, and t is 0 or 1, Y is NR^9, and R^8 and R^9, taken together with the nitrogen atom, form a group selected from **s**, **t**, **u**, or **v**, and wherein r is 0 or 1, and WR^W substituents are halogen, C_{1-4}alkyl, $-(R)_2$, -OR, -SR, $-SO_2N(R)_2$, $-N(R)SO_2R$, -N(R)COR, $-N(R)_2$, $-CH_2OR$, $-CH_2N(R)_2$, or $-CH_2SR$; and

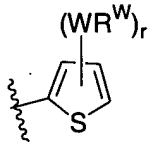
c. R^3 is hydrogen.

[00148] In other embodiments, for compounds of formulas **IV, V, VI** and **VII**, including those compounds described in preferred subsets directly above, q is 1, and ZR^Z is in the meta position and ZR^Z is $-NH_2$, -OH, C_{1-4}alkoxy, or $-S(O)_2NH_2$.

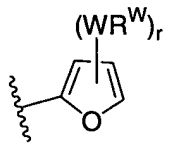
[00149] In yet other embodiments, for compounds of formulas **IV, V, VI** and **VII**, including those compounds described in preferred subsets directly above, when t is 0, and Y is a direct bond, R^8 is from:



b-i



k-i

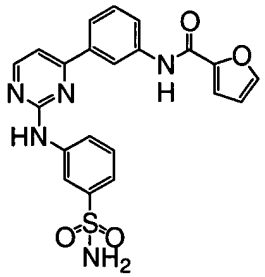


l-i

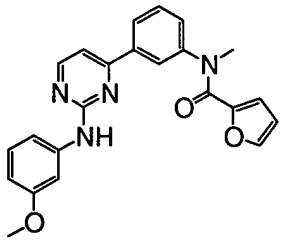
[00150] In still other embodiments, for compounds of formulas **IV, V, VI** and **VII**, including those compounds described in subsets directly above, when t is 0 or 1, and Y is NR^9, then R^8 and R^9, taken together form an optionally substituted group selected from **s**, **u** or **v**. In other embodiments, R^8 and R^9, taken together, form an optionally substituted group **s** or **v**. In yet other embodiments, R^8 and R^9, taken together form a group **s** or **v**, which group is substituted with one occurrence of OH, or CH_2OH.

[00151] Representative examples of compounds of formula **IV-A(i), IV-B(i), IV-C(i), IV-D(i), V-A(i), V-B(i), V-C(i),** and **V-D(i)** are set forth below in Tables 1, 2, 3, 4, 5, 6, 7 and 8.

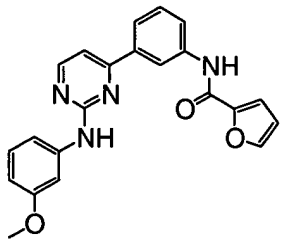
[00152] Table 1. Examples of Compounds of Formula **IV-A(i)**:



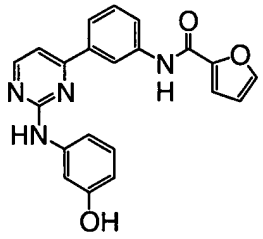
IV-A(i)-1



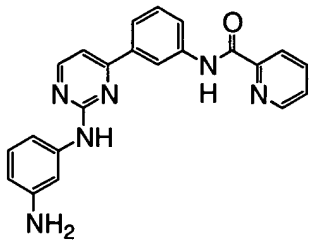
IV-A(i)-2



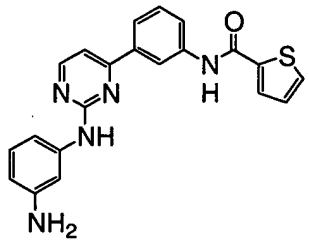
IV-A(i)-3



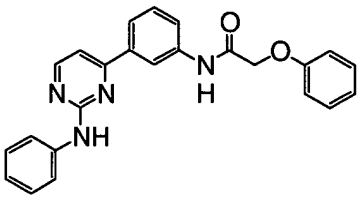
IV-A(i)-4



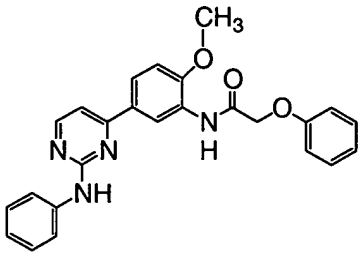
IV-A(i)-5



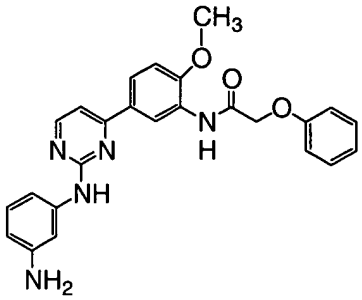
IV-A(i)-6

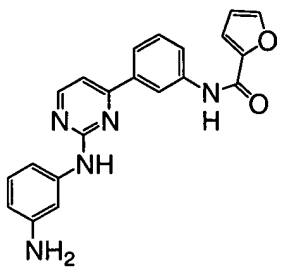


IV-A(i)-7

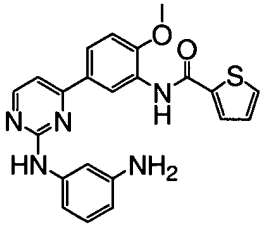


IV-A(i)-8

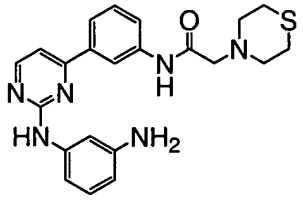


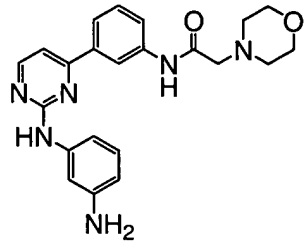


IV-A(i)-9



IV-A(i)-10



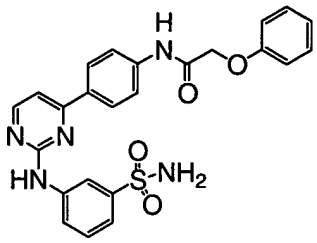


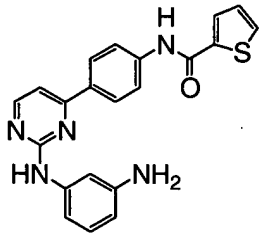
IV-A(i)-11

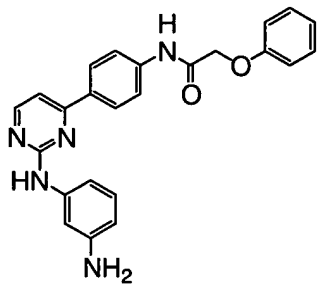
IV-A(i)-12

IV-A(i)-13

[00153] Table 2. Examples of Compounds of Formula **IV-B(i)**:



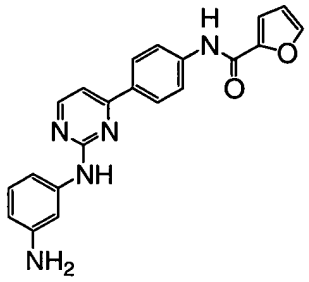


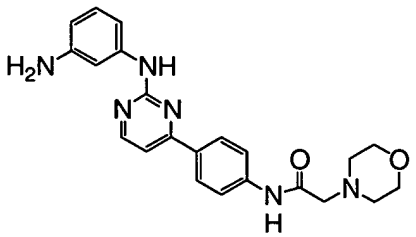


IV-B(i)-1

IV-B(i)-2

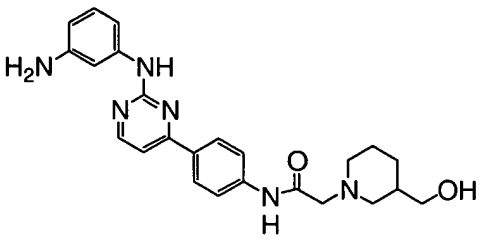
IV-B(i)-3

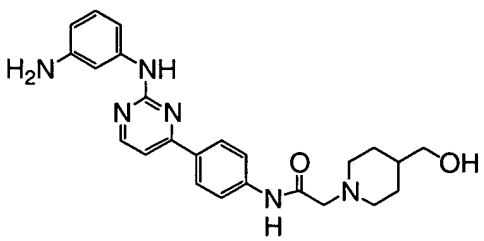




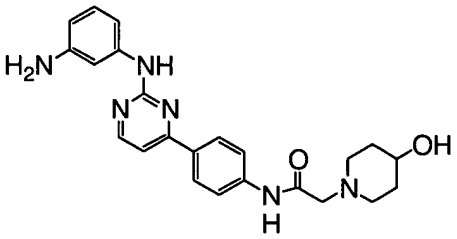
IV-B(i)-4

IV-B(i)-5

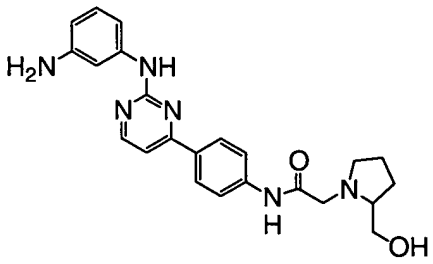




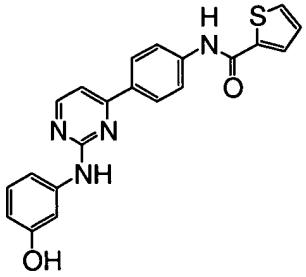
IV-B(i)-6



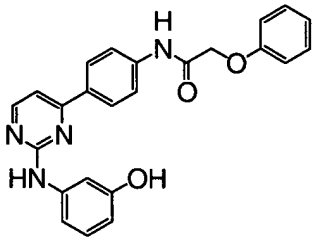
IV-B(i)-7



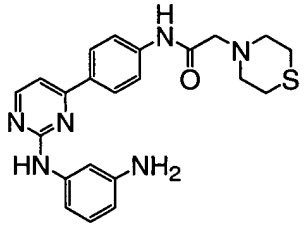
IV-B(i)-8



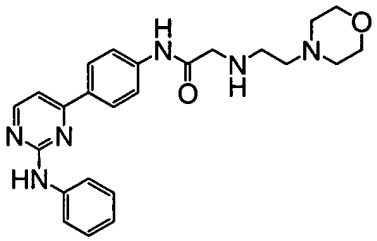
IV-B(i)-9



IV-B(i)-10

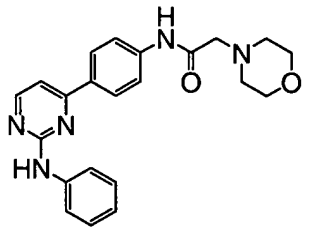


IV-B(i)-11

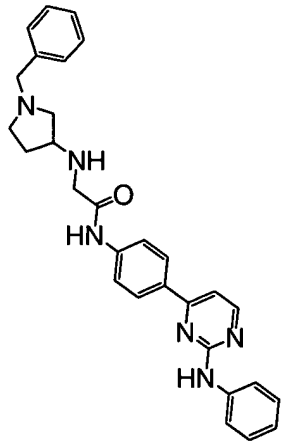


IV-B(i)-12

IV-B(i)-13

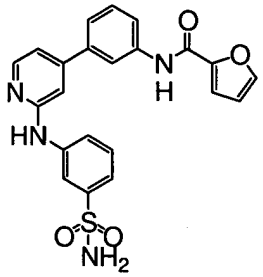


IV-B(i)-14

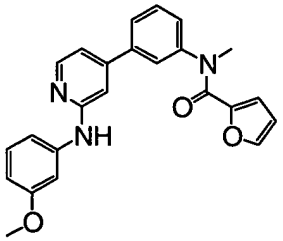


IV-B(i)-15

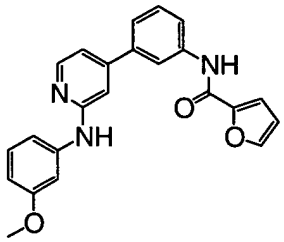
[00154] Table 3. Examples of Compounds of Formula **V-A(i)**:



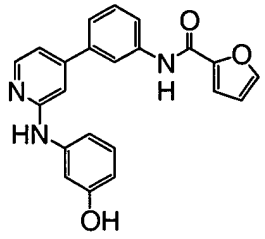
V-A(i)-1



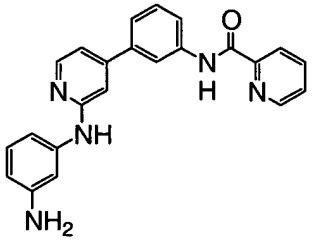
V-A(i)-2



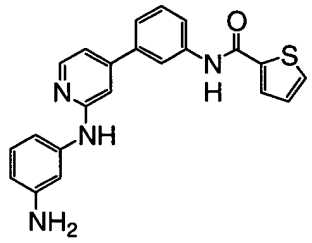
V-A(i)-3



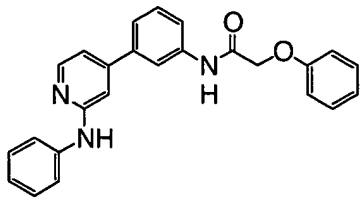
V-A(i)-4



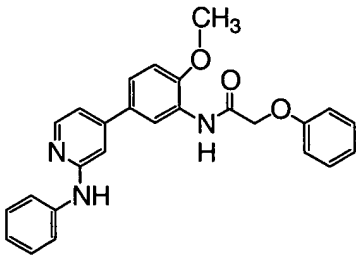
V-A(i)-5



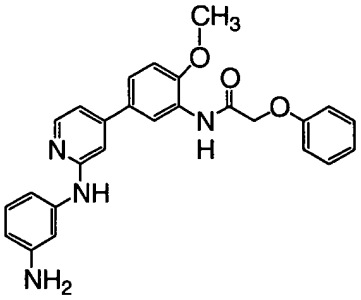
V-A(i)-6



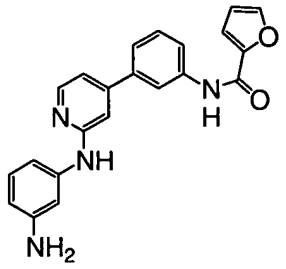
V-A(i)-7



V-A(i)-8

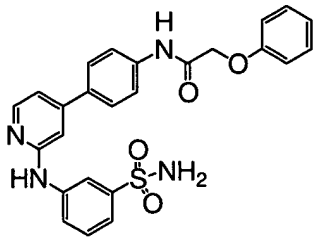


V-A(i)-9

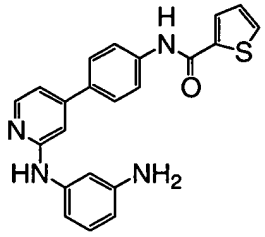


V-A(i)-10

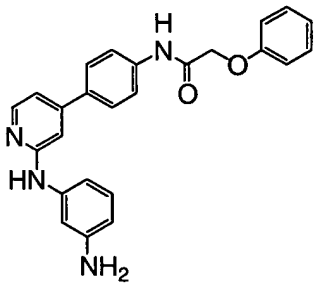
[00155] Table 4. Examples of Compounds of Formula **V-B(i)**:



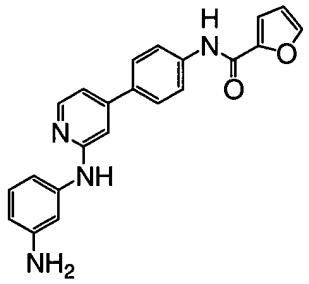
V-B(i)-1



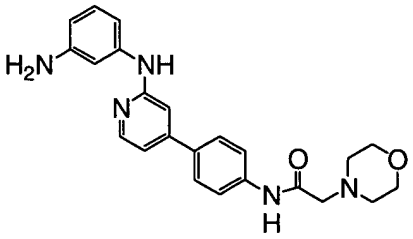
V-B(i)-2



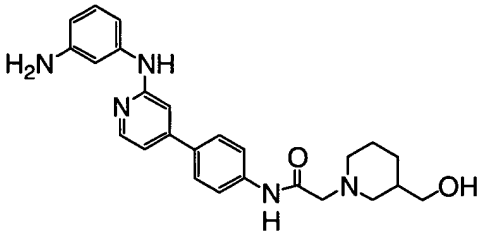
V-B(i)-3



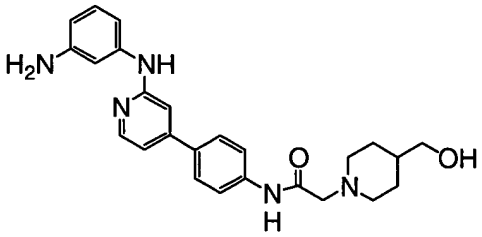
V-B(i)-4



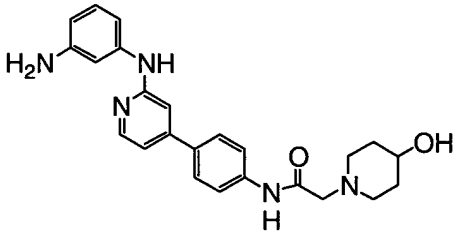
V-B(i)-5



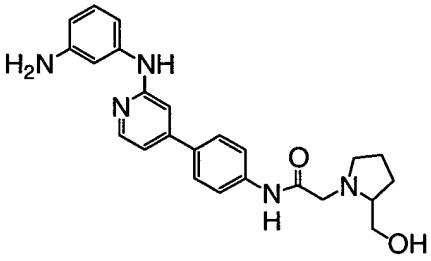
V-B(i)-6



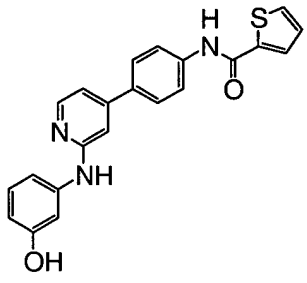
V-B(i)-7



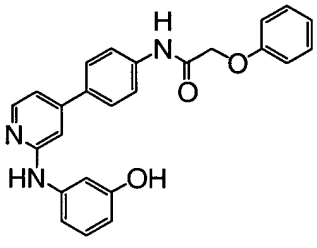
V-B(i)-8



V-B(i)-9

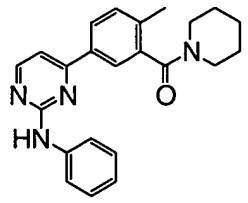


V-B(i)-10

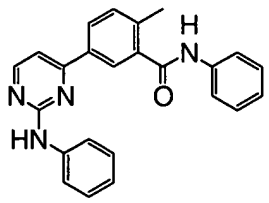


V-B(i)-11

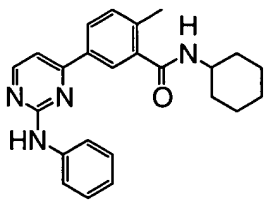
[00156] Table 5. Examples of Compounds of Formula **IV-C(i)**:



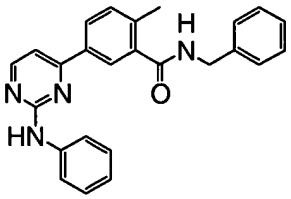
IV-C(i)-1



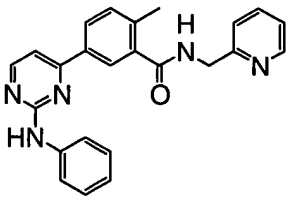
IV-C(i)-2



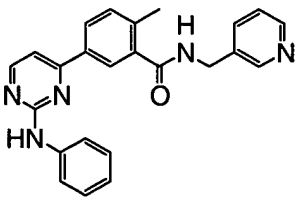
IV-C(i)-3



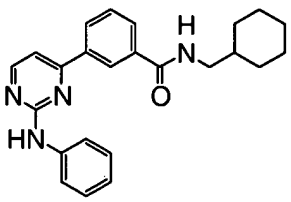
IV-C(i)-4



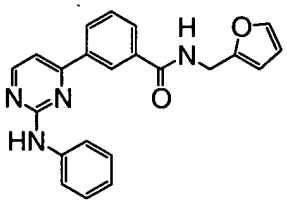
IV-C(i)-5



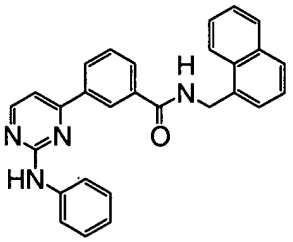
IV-C(i)-6



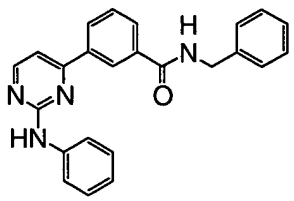
IV-C(i)-7



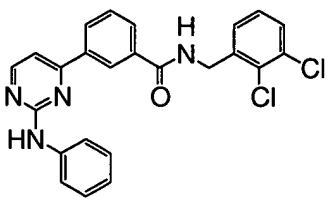
IV-C(i)-8



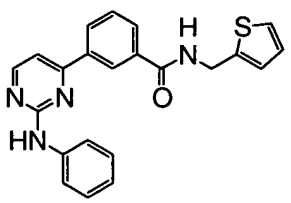
IV-C(i)-9



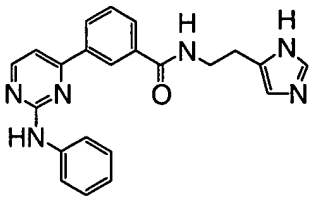
IV-C(i)-10



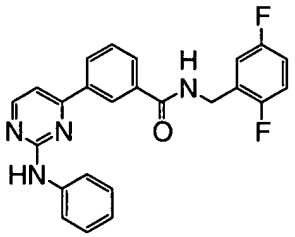
IV-C(i)-11



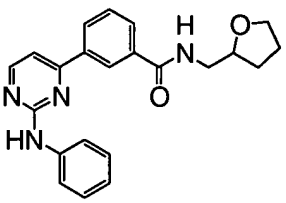
IV-C(i)-12



IV-C(i)-13

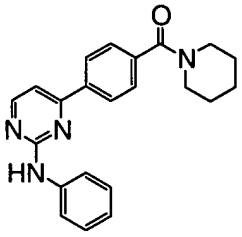


IV-C(i)-14

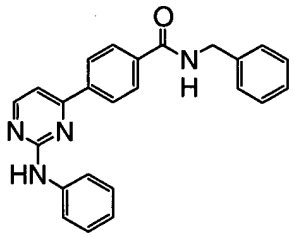


IV-C(i)-15

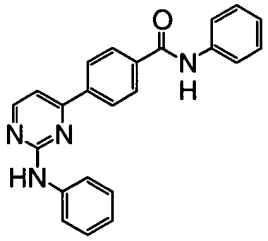
[00157] Table 6. Examples of Compounds of Formula **IV-D(i)**:



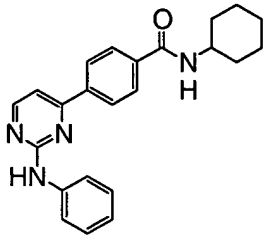
IV-D(i)-1



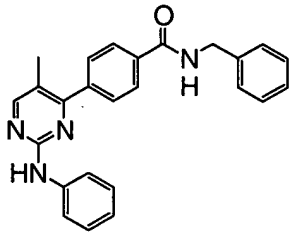
IV-D(i)-2



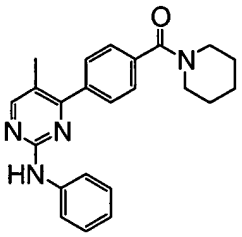
IV-D(i)-3



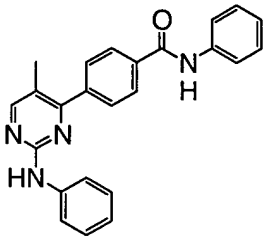
IV-D(i)-4



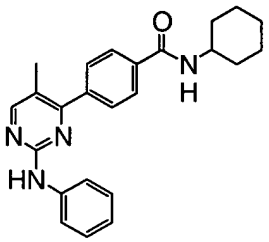
IV-D(i)-5



IV-D(i)-6

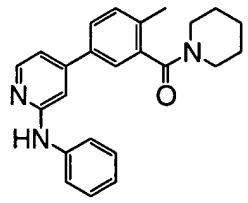


IV-D(i)-7

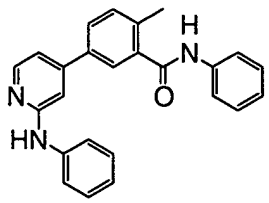


IV-D(i)-8

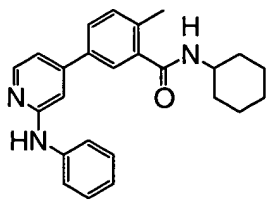
[00158] Table 7. Examples of Compounds of Formula **V-C(i)**:



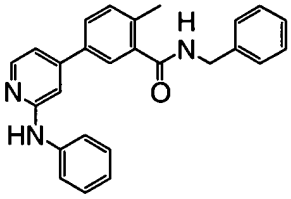
V-C(i)-1



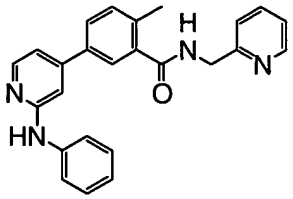
V-C(i)-2



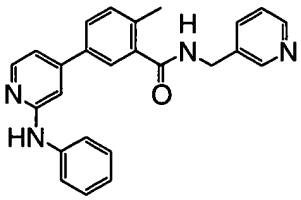
V-C(i)-3



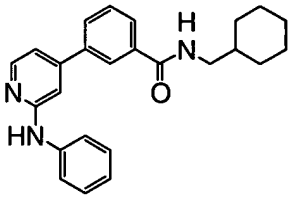
V-C(i)-4



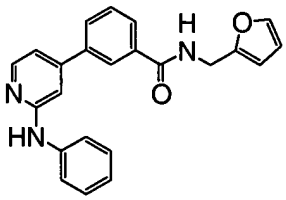
V-C(i)-5



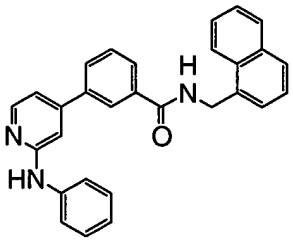
V-C(i)-6



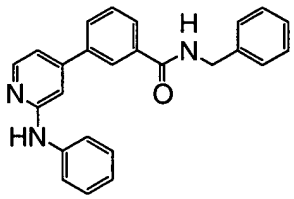
V-C(i)-7



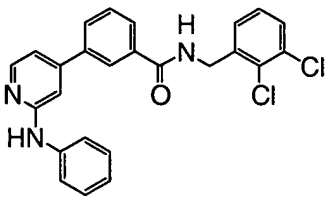
V-C(i)-8



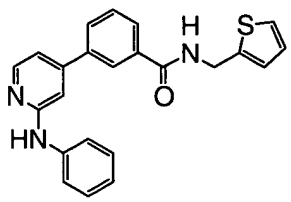
V-C(i)-9



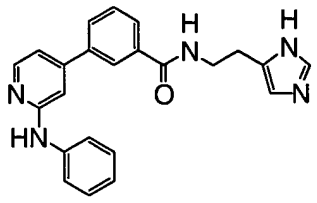
V-C(i)-10



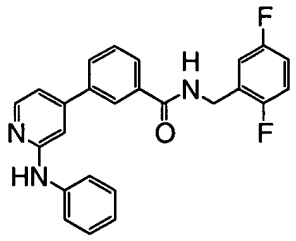
V-C(i)-11



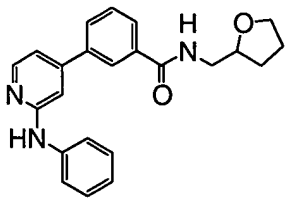
V-C(i)-12



V-C(i)-13

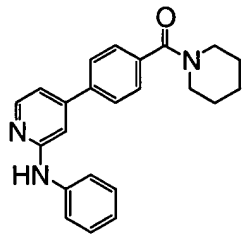


V-C(i)-14

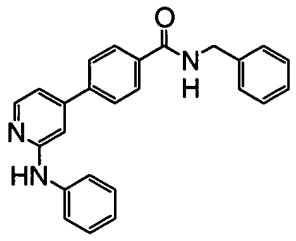


V-C(i)-15

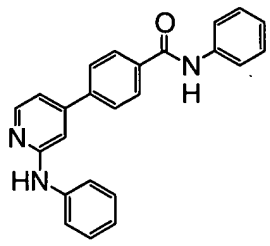
[00159] Table 8. Examples of Compounds of Formula **V-D(i)**:



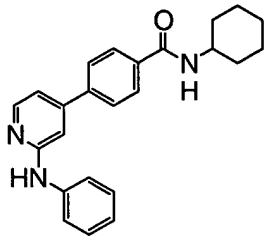
V-D(i)-1



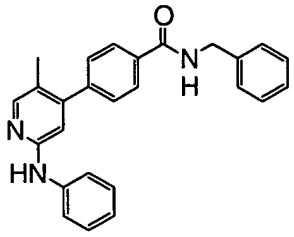
V-D(i)-2



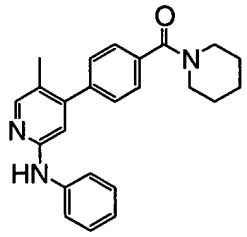
V-D(i)-3



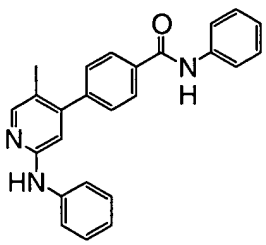
V-D(i)-4

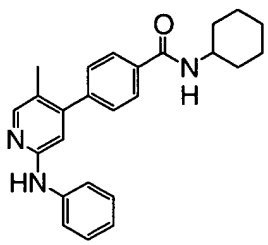


V-D(i)-5



V-D(i)-6





V-D(i)-7 V-D(i)-8

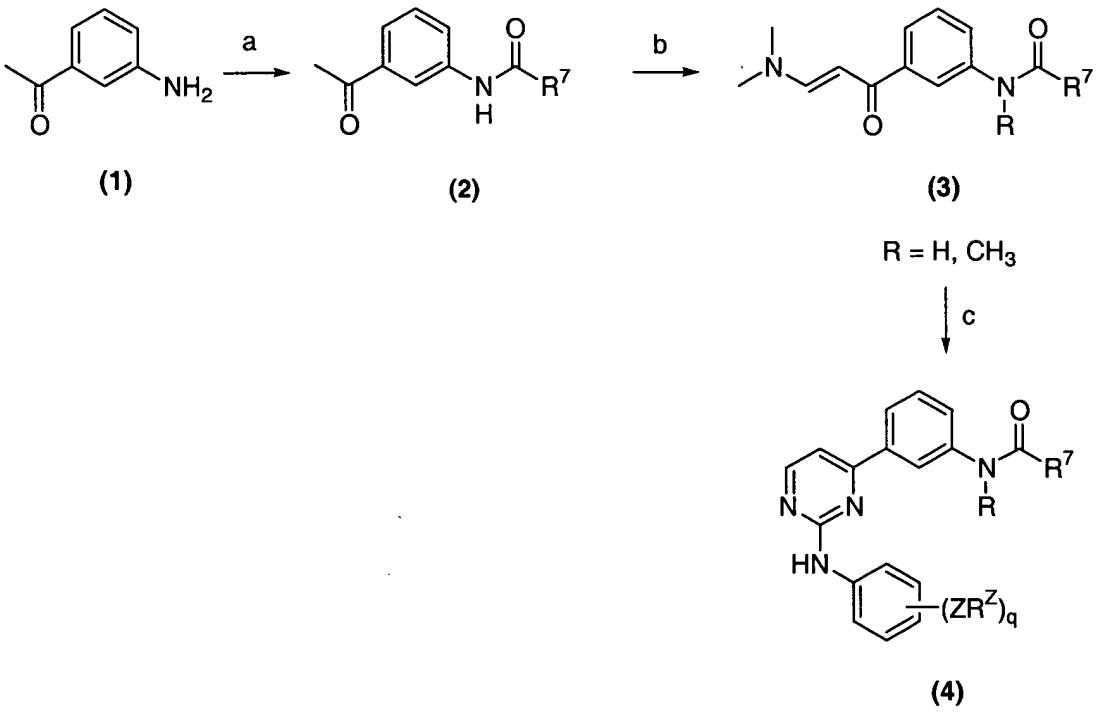
[00160] *III. General Synthetic Methodology:*

[00161] The compounds of this invention may be prepared in general by methods known to those skilled in the art for analogous compounds, as illustrated by the general schemes below, and the preparative examples that follow.

[00162] Scheme I below depicts a method for an exemplary synthesis for certain compounds described herein where R^3 or R^4 is $-NRCO(R^7)$. In general, as depicted below, 3-aminoacetophenone **(1)** was reacted with an appropriate aryl chloride in the presence of ethyl-di-isopropylamine. The resulting amide **(2)** was then treated with dimethylfomamide-dimethyl acetal (DMF-DMA) to generate the intermediate acryloyl **(3)**. Subsequent reaction with a substituted phenylguanidine yields the desired compound. Compounds **1** and **2** and **3** are useful intermediates in forming a variety of compounds of formula **I** using methods known to one of skill in the art and as illustrated in the Examples below.

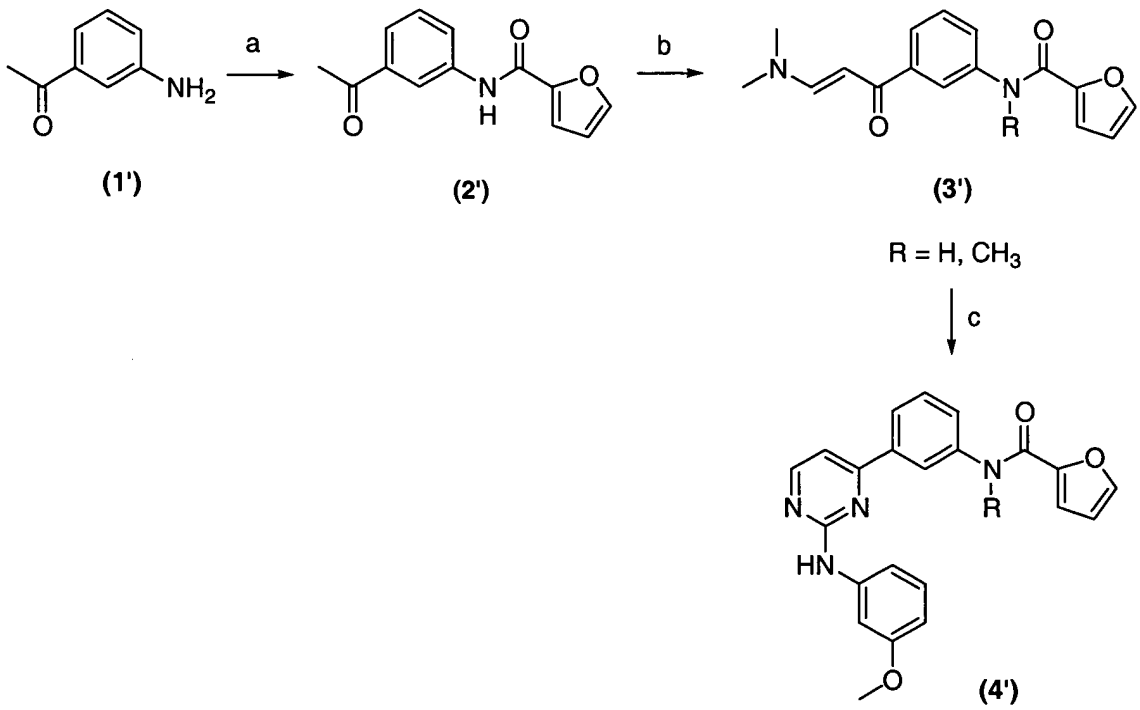
[00163] Scheme II is directed to certain exemplary compounds as described herein. 3-aminoacetophenone **(1')** was reacted with 2-furoyl chloride in the presence of ethyl-di-isopropylamine. The resulting amide **(2')** was then treated with dimethylfomamide-dimethyl acetal (DMF-DMA) to generate the intermediate acryloyl **(3')**. Subsequent reaction with 3-MeO-phenylguanidine yields the desired compound. Compounds **1'** and **2'** and **3'** are useful intermediates in forming a variety of compounds of formula **I** using methods known to one of skill in the art and as illustrated in the Examples below.

[00164] Scheme I



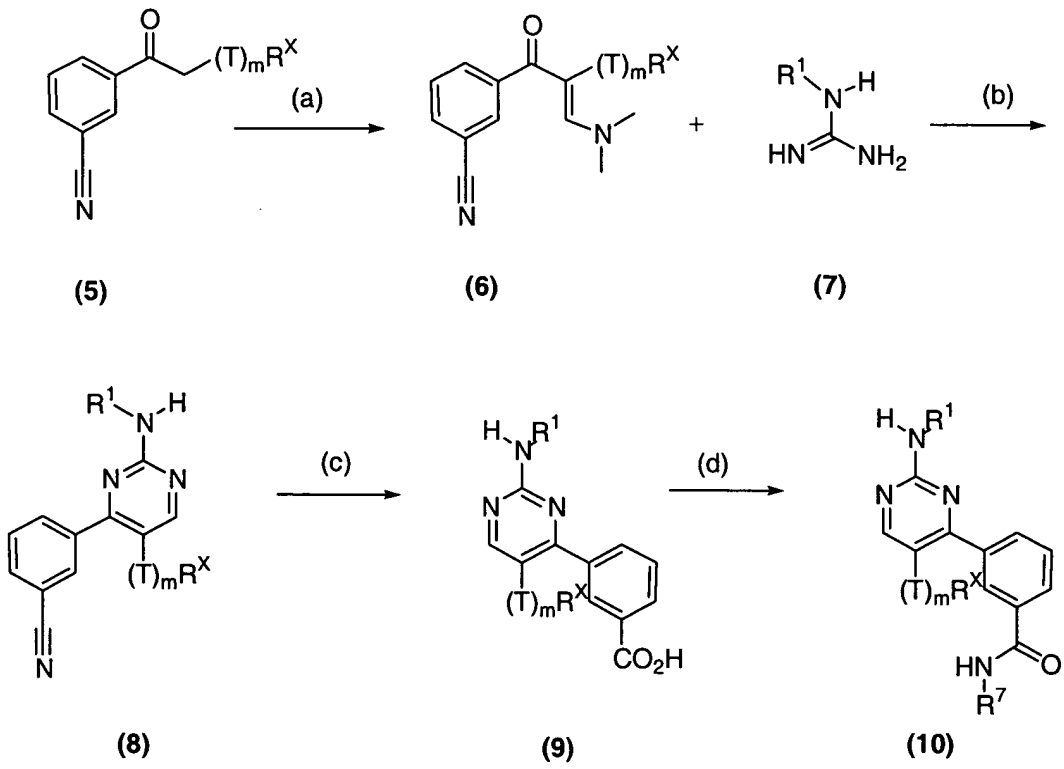
Reagents: a. $ClC(O)R^7$, *i* -Pr_2EtN; b. DMF-DMA (solvent), 100 °C; c. optionally substituted phenylguanidine, NaOMe, DMF, 100 °C.

[00165] Scheme II



Reagents: a. 2-furoyl chloride, *i* -Pr_2EtN; b. DMF-DMA (solvent), 100 °C; c. 3-MeO-phenylguanidine, NaOMe, DMF, 100 °C.

[00166] Scheme III below depicts a method for an exemplary synthesis for certain compounds described herein where R^3 or R^4 is –CONR(R^7). In step (a), the enamine intermediate **(6)** is prepared by treating **(5)** with $Me_2NC(OMe)_2H$ at reflux. The formation of the pyrimidine compound **(8)** at step (b) is achieved by the treatment of enamine **(6)** with guanidine **(7)** at elevated temperature. The cyano group of intermediate **(8)** is hydrolized according to step (c) to form the carboxylic acid **(9)** which is then treated with a variety of amines of formula R^1-NH_2 to form the amide compounds of formula **(10)**. It would be apparent to one of skill in the art that a wide variety of amines of formula R^1-NH_2 are amenable to couple to the carboxylic acid **(9)** by methods known in the art.



Reagents and conditions: (a) $Me_2NC(OMe)_2H$, reflux, 12 hours; (b) CH_3CN, reflux, 12 hours; (c) conc. HCl, reflux, 12 hours; (d) $H_2N\text{-}R^1$, EDCI, HOBt, THF, 12 hours, RT.

[00167] *5. Uses, Formulation and Administration*

[00168] *Pharmaceutically acceptable compositions*

[00169] As discussed above, the present invention provides compounds that are inhibitors of protein kinases, and thus the present compounds are useful for the treatment of diseases, disorders, and conditions including, but not limited to a proliferative disorder, a cardiac disorder, a neurodegenerative disorder, psychotic disorders, an autoimmune disorder, a condition associated with organ transplant, an inflammatory disorder, an immunologically mediated disorder, a viral disease, or a bone disorder. In preferred embodiments, the compounds are useful for the treatment of allergy, asthma, diabetes, Alzheimer's disease, Huntington's disease, Parkinson's disease, AIDS-associated dementia, amyotrophic lateral sclerosis (AML, Lou Gehrig's disease), multiple sclerosis (MS), schizophrenia, cardiomyocyte hypertrophy, reperfusion/ischemia (e.g., stroke), baldness, cancer, hepatomegaly, cardiovascular disease including cardiomegaly, cystic fibrosis, viral disease, autoimmune diseases, atherosclerosis,

restenosis, psoriasis, inflammation, hypertension, angina pectoris, cerebrovascular contraction, peripheral circulation disorder, premature birth, arteriosclerosis, vasospasm (cerebral vasospasm, coronary vasospasm), retinopathy, erectile dysfunction (ED), AIDS, osteoporosis, Crohn's Disease and colitis, neurite outgrowth, and Raynaud's Disease. In preferred embodiments, the disease, condition, or disorder is atherosclerosis, hypertension, erectile dysfunction (ED), reperfusion/ischemia (e.g., stroke), or vasospasm (cerebral vasospasm and coronary vasospasm).

[00170] Accordingly, in another aspect of the present invention, pharmaceutically acceptable compositions are provided, wherein these compositions comprise any of the compounds as described herein, and optionally comprise a pharmaceutically acceptable carrier, adjuvant or vehicle. In certain embodiments, these compositions optionally further comprise one or more additional therapeutic agents.

[00171] It will also be appreciated that certain of the compounds of present invention can exist in free form for treatment, or where appropriate, as a pharmaceutically acceptable derivative thereof. According to the present invention, a pharmaceutically acceptable derivative includes, but is not limited to, pharmaceutically acceptable prodrugs, salts, esters, salts of such esters, or any other adduct or derivative which upon administration to a patient in need is capable of providing, directly or indirectly, a compound as otherwise described herein, or a metabolite or residue thereof.

[00172] As used herein, the term "pharmaceutically acceptable salt" refers to those salts which are, within the scope of sound medical judgement, suitable for use in contact with the tissues of humans and lower animals without undue toxicity, irritation, allergic response and the like, and are commensurate with a reasonable benefit/risk ratio. A "pharmaceutically acceptable salt" means any non-toxic salt or salt of an ester of a compound of this invention that, upon administration to a recipient, is capable of providing, either directly or indirectly, a compound of this invention or an inhibitorily active metabolite or residue thereof. As used herein, the term "inhibitorily active metabolite or residue thereof" means that a metabolite or residue thereof is also an inhibitor of a JAK, JNK, CDK, and ZAP-70 kinase.

[00173] Pharmaceutically acceptable salts are well known in the art. For example, S. M. Berge *et al.,* describe pharmaceutically acceptable salts in detail in *J. Pharmaceutical Sciences*, **1977**, *66*, 1-19, incorporated herein by reference. Pharmaceutically acceptable salts of the compounds of this invention include those derived from suitable inorganic and organic acids and

bases. Examples of pharmaceutically acceptable, nontoxic acid addition salts are salts of an amino group formed with inorganic acids such as hydrochloric acid, hydrobromic acid, phosphoric acid, sulfuric acid and perchloric acid or with organic acids such as acetic acid, oxalic acid, maleic acid, tartaric acid, citric acid, succinic acid or malonic acid or by using other methods used in the art such as ion exchange. Other pharmaceutically acceptable salts include adipate, alginate, ascorbate, aspartate, benzenesulfonate, benzoate, bisulfate, borate, butyrate, camphorate, camphorsulfonate, citrate, cyclopentanepropionate, digluconate, dodecylsulfate, ethanesulfonate, formate, fumarate, glucoheptonate, glycerophosphate, gluconate, hemisulfate, heptanoate, hexanoate, hydroiodide, 2-hydroxy-ethanesulfonate, lactobionate, lactate, laurate, lauryl sulfate, malate, maleate, malonate, methanesulfonate, 2-naphthalenesulfonate, nicotinate, nitrate, oleate, oxalate, palmitate, pamoate, pectinate, persulfate, 3-phenylpropionate, phosphate, picrate, pivalate, propionate, stearate, succinate, sulfate, tartrate, thiocyanate, p-toluenesulfonate, undecanoate, valerate salts, and the like. Salts derived from appropriate bases include alkali metal, alkaline earth metal, ammonium and $N^+(C_{1-4}alkyl)_4$ salts. This invention also envisions the quaternization of any basic nitrogen-containing groups of the compounds disclosed herein. Water or oil-soluble or dispersable products may be obtained by such quaternization. Representative alkali or alkaline earth metal salts include sodium, lithium, potassium, calcium, magnesium, and the like. Further pharmaceutically acceptable salts include, when appropriate, nontoxic ammonium, quaternary ammonium, and amine cations formed using counterions such as halide, hydroxide, carboxylate, sulfate, phosphate, nitrate, loweralkyl sulfonate and aryl sulfonate.

[00174] As described above, the pharmaceutically acceptable compositions of the present invention additionally comprise a pharmaceutically acceptable carrier, adjuvant, or vehicle, which, as used herein, includes any and all solvents, diluents, or other liquid vehicle, dispersion or suspension aids, surface active agents, isotonic agents, thickening or emulsifying agents, preservatives, solid binders, lubricants and the like, as suited to the particular dosage form desired. Remington's Pharmaceutical Sciences, Sixteenth Edition, E. W. Martin (Mack Publishing Co., Easton, Pa., 1980) discloses various carriers used in formulating pharmaceutically acceptable compositions and known techniques for the preparation thereof. Except insofar as any conventional carrier medium is incompatible with the compounds of the invention, such as by producing any undesirable biological effect or otherwise interacting in a

deleterious manner with any other component(s) of the pharmaceutically acceptable composition, its use is contemplated to be within the scope of this invention. Some examples of materials which can serve as pharmaceutically acceptable carriers include, but are not limited to, ion exchangers, alumina, aluminum stearate, lecithin, serum proteins, such as human serum albumin, buffer substances such as phosphates, glycine, sorbic acid, or potassium sorbate, partial glyceride mixtures of saturated vegetable fatty acids, water, salts or electrolytes, such as protamine sulfate, disodium hydrogen phosphate, potassium hydrogen phosphate, sodium chloride, zinc salts, colloidal silica, magnesium trisilicate, polyvinyl pyrrolidone, polyacrylates, waxes, polyethylene-polyoxypropylene-block polymers, wool fat, sugars such as lactose, glucose and sucrose; starches such as corn starch and potato starch; cellulose and its derivatives such as sodium carboxymethyl cellulose, ethyl cellulose and cellulose acetate; powdered tragacanth; malt; gelatin; talc; excipients such as cocoa butter and suppository waxes; oils such as peanut oil, cottonseed oil; safflower oil; sesame oil; olive oil; corn oil and soybean oil; glycols; such a propylene glycol or polyethylene glycol; esters such as ethyl oleate and ethyl laurate; agar; buffering agents such as magnesium hydroxide and aluminum hydroxide; alginic acid; pyrogen-free water; isotonic saline; Ringer's solution; ethyl alcohol, and phosphate buffer solutions, as well as other non-toxic compatible lubricants such as sodium lauryl sulfate and magnesium stearate, as well as coloring agents, releasing agents, coating agents, sweetening, flavoring and perfuming agents, preservatives and antioxidants can also be present in the composition, according to the judgment of the formulator.

[00175] *Uses of Compounds and Pharmaceutically acceptable compositions*

[00176] In yet another aspect, a method for the treatment or lessening the severity of a proliferative disorder, a cardiac disorder, a neurodegenerative disorder, a psychotic disorder, an autoimmune disorder, a condition associated with organ transplant, an inflammatory disorder, an immunologically mediated disorder, a viral disease, or a bone disorder is provided comprising administering an effective amount of a compound, or a pharmaceutically acceptable composition comprising a compound to a subject in need thereof. In certain embodiments of the present invention an "effective amount" of the compound or pharmaceutically acceptable composition is that amount effective for treating or lessening the severity of a proliferative disorder, a cardiac disorder, a neurodegenerative disorder, a psychotic disorder, an autoimmune disorder, a

condition associated with organ transplant, an inflammatory disorder, an immunologically mediated disorder, a viral disease, or a bone disorder. The compounds and compositions, according to the method of the present invention, may be administered using any amount and any route of administration effective for treating or lessening the severity of a proliferative disorder, a cardiac disorder, a neurodegenerative disorder, an autoimmune disorder, a condition associated with organ transplant, an inflammatory disorder, an immunologically mediated disorder, a viral disease, or a bone disorder. The exact amount required will vary from subject to subject, depending on the species, age, and general condition of the subject, the severity of the infection, the particular agent, its mode of administration, and the like. The compounds of the invention are preferably formulated in dosage unit form for ease of administration and uniformity of dosage. The expression "dosage unit form" as used herein refers to a physically discrete unit of agent appropriate for the patient to be treated. It will be understood, however, that the total daily usage of the compounds and compositions of the present invention will be decided by the attending physician within the scope of sound medical judgment. The specific effective dose level for any particular patient or organism will depend upon a variety of factors including the disorder being treated and the severity of the disorder; the activity of the specific compound employed; the specific composition employed; the age, body weight, general health, sex and diet of the patient; the time of administration, route of administration, and rate of excretion of the specific compound employed; the duration of the treatment; drugs used in combination or coincidental with the specific compound employed, and like factors well known in the medical arts. The term "patient", as used herein, means an animal, preferably a mammal, and most preferably a human.

[00177] The pharmaceutically acceptable compositions of this invention can be administered to humans and other animals orally, rectally, parenterally, intracisternally, intravaginally, intraperitoneally, topically (as by powders, ointments, or drops), bucally, as an oral or nasal spray, or the like, depending on the severity of the infection being treated. In certain embodiments, the compounds of the invention may be administered orally or parenterally at dosage levels of about 0.01 mg/kg to about 50 mg/kg and preferably from about 1 mg/kg to about 25 mg/kg, of subject body weight per day, one or more times a day, to obtain the desired therapeutic effect.

[00178] Liquid dosage forms for oral administration include, but are not limited to, pharmaceutically acceptable emulsions, microemulsions, solutions, suspensions, syrups and

elixirs. In addition to the active compounds, the liquid dosage forms may contain inert diluents commonly used in the art such as, for example, water or other solvents, solubilizing agents and emulsifiers such as ethyl alcohol, isopropyl alcohol, ethyl carbonate, ethyl acetate, benzyl alcohol, benzyl benzoate, propylene glycol, 1,3-butylene glycol, dimethylformamide, oils (in particular, cottonseed, groundnut, corn, germ, olive, castor, and sesame oils), glycerol, tetrahydrofurfuryl alcohol, polyethylene glycols and fatty acid esters of sorbitan, and mixtures thereof. Besides inert diluents, the oral compositions can also include adjuvants such as wetting agents, emulsifying and suspending agents, sweetening, flavoring, and perfuming agents.

[00179] Injectable preparations, for example, sterile injectable aqueous or oleaginous suspensions may be formulated according to the known art using suitable dispersing or wetting agents and suspending agents. The sterile injectable preparation may also be a sterile injectable solution, suspension or emulsion in a nontoxic parenterally acceptable diluent or solvent, for example, as a solution in 1,3-butanediol. Among the acceptable vehicles and solvents that may be employed are water, Ringer's solution, U.S.P. and isotonic sodium chloride solution. In addition, sterile, fixed oils are conventionally employed as a solvent or suspending medium. For this purpose any bland fixed oil can be employed including synthetic mono- or diglycerides. In addition, fatty acids such as oleic acid are used in the preparation of injectables.

[00180] The injectable formulations can be sterilized, for example, by filtration through a bacterial-retaining filter, or by incorporating sterilizing agents in the form of sterile solid compositions which can be dissolved or dispersed in sterile water or other sterile injectable medium prior to use.

[00181] In order to prolong the effect of a compound of the present invention, it is often desirable to slow the absorption of the compound from subcutaneous or intramuscular injection. This may be accomplished by the use of a liquid suspension of crystalline or amorphous material with poor water solubility. The rate of absorption of the compound then depends upon its rate of dissolution that, in turn, may depend upon crystal size and crystalline form. Alternatively, delayed absorption of a parenterally administered compound form is accomplished by dissolving or suspending the compound in an oil vehicle. Injectable depot forms are made by forming microencapsule matrices of the compound in biodegradable polymers such as polylactide-polyglycolide. Depending upon the ratio of compound to polymer and the nature of the particular polymer employed, the rate of compound release can be controlled. Examples of other

biodegradable polymers include poly(orthoesters) and poly(anhydrides). Depot injectable formulations are also prepared by entrapping the compound in liposomes or microemulsions that are compatible with body tissues.

[00182] Compositions for rectal or vaginal administration are preferably suppositories which can be prepared by mixing the compounds of this invention with suitable non-irritating excipients or carriers such as cocoa butter, polyethylene glycol or a suppository wax which are solid at ambient temperature but liquid at body temperature and therefore melt in the rectum or vaginal cavity and release the active compound.

[00183] Solid dosage forms for oral administration include capsules, tablets, pills, powders, and granules. In such solid dosage forms, the active compound is mixed with at least one inert, pharmaceutically acceptable excipient or carrier such as sodium citrate or dicalcium phosphate and/or a) fillers or extenders such as starches, lactose, sucrose, glucose, mannitol, and silicic acid, b) binders such as, for example, carboxymethylcellulose, alginates, gelatin, polyvinylpyrrolidinone, sucrose, and acacia, c) humectants such as glycerol, d) disintegrating agents such as agar--agar, calcium carbonate, potato or tapioca starch, alginic acid, certain silicates, and sodium carbonate, e) solution retarding agents such as paraffin, f) absorption accelerators such as quaternary ammonium compounds, g) wetting agents such as, for example, cetyl alcohol and glycerol monostearate, h) absorbents such as kaolin and bentonite clay, and i) lubricants such as talc, calcium stearate, magnesium stearate, solid polyethylene glycols, sodium lauryl sulfate, and mixtures thereof. In the case of capsules, tablets and pills, the dosage form may also comprise buffering agents.

[00184] Solid compositions of a similar type may also be employed as fillers in soft and hard-filled gelatin capsules using such excipients as lactose or milk sugar as well as high molecular weight polyethylene glycols and the like. The solid dosage forms of tablets, dragees, capsules, pills, and granules can be prepared with coatings and shells such as enteric coatings and other coatings well known in the pharmaceutical formulating art. They may optionally contain opacifying agents and can also be of a composition that they release the active ingredient(s) only, or preferentially, in a certain part of the intestinal tract, optionally, in a delayed manner. Examples of embedding compositions that can be used include polymeric substances and waxes. Solid compositions of a similar type may also be employed as fillers in soft and hard-filled

gelatin capsules using such excipients as lactose or milk sugar as well as high molecular weight polethylene glycols and the like.

[00185] The active compounds can also be in micro-encapsulated form with one or more excipients as noted above. The solid dosage forms of tablets, dragees, capsules, pills, and granules can be prepared with coatings and shells such as enteric coatings, release controlling coatings and other coatings well known in the pharmaceutical formulating art. In such solid dosage forms the active compound may be admixed with at least one inert diluent such as sucrose, lactose or starch. Such dosage forms may also comprise, as is normal practice, additional substances other than inert diluents, e.g., tableting lubricants and other tableting aids such a magnesium stearate and microcrystalline cellulose. In the case of capsules, tablets and pills, the dosage forms may also comprise buffering agents. They may optionally contain opacifying agents and can also be of a composition that they release the active ingredient(s) only, or preferentially, in a certain part of the intestinal tract, optionally, in a delayed manner. Examples of embedding compositions that can be used include polymeric substances and waxes.

[00186] Dosage forms for topical or transdermal administration of a compound of this invention include ointments, pastes, creams, lotions, gels, powders, solutions, sprays, inhalants or patches. The active component is admixed under sterile conditions with a pharmaceutically acceptable carrier and any needed preservatives or buffers as may be required. Ophthalmic formulation, ear drops, and eye drops are also contemplated as being within the scope of this invention. Additionally, the present invention contemplates the use of transdermal patches, which have the added advantage of providing controlled delivery of a compound to the body. Such dosage forms can be made by dissolving or dispensing the compound in the proper medium. Absorption enhancers can also be used to increase the flux of the compound across the skin. The rate can be controlled by either providing a rate controlling membrane or by dispersing the compound in a polymer matrix or gel.

[00187] As described generally above, the compounds of the invention are useful as inhibitors of protein kinases. In one embodiment, the compounds and compositions of the invention are inhibitors of one or more of JAK, JNK, CDK, and ZAP-70, and thus, without wishing to be bound by any particular theory, the compounds and compositions are particularly useful for treating or lessening the severity of a disease, condition, or disorder where activation of one or more of JAK, JNK, CDK, and ZAP-70 is implicated in the disease, condition, or disorder.

When activation of JAK, JNK, CDK, and ZAP-70 is implicated in a particular disease, condition, or disorder, the disease, condition, or disorder may also be referred to as "JAK, JNK, CDK, and ZAP-70-mediated disease" or disease symptom. Accordingly, in another aspect, the present invention provides a method for treating or lessening the severity of a disease, condition, or disorder where activation or one or more of JAK, JNK, CDK, and ZAP-70 is implicated in the disease state.

[00188] The activity of a compound utilized in this invention as an inhibitor of JAK, JNK, CDK, and ZAP-70, may be assayed *in vitro, in vivo* or in a cell line. *In vitro* assays include assays that determine inhibition of either the phosphorylation activity or ATPase activity of activated JAK, JNK, CDK, and ZAP-70. Alternate *in vitro* assays quantitate the ability of the inhibitor to bind to JAK, JNK, CDK, and ZAP-70. Inhibitor binding may be measured by radiolabelling the inhibitor prior to binding, isolating the inhibitor/JAK, inhibitor/JNK, inhibitor/CDK, or inhibitor/ZAP-70 complex and determining the amount of radiolabel bound. Alternatively, inhibitor binding may be determined by running a competition experiment where new inhibitors are incubated with JAK, JNK, CDK, and ZAP-70 bound to known radioligands.

[00189] The term "measurably inhibit", as used herein means a measurable change in JAK, JNK, CDK, and ZAP-70 activity between a sample comprising said composition and a JAK, JNK, CDK, and ZAP-70 kinase and an equivalent sample comprising JAK, JNK, CDK, and ZAP-70 kinase in the absence of said composition.

[00190] The term "JAK-mediated disease", as used herein means any disease or other deleterious condition in which a JAK family kinase is known to play a role. Such conditions include, without limitation, immune responses such as allergic or type I hypersensitivity reactions, asthma, autoimmune diseases such as transplant rejection, graft versus host disease, rheumatoid arthritis, amyotrophic lateral sclerosis, and multiple sclerosis, neurodegenerative disorders such as Familial amyotrophic lateral sclerosis (FALS), as well as in solid and hematologic malignancies such as leukemias and lymphomas.

[00191] According to another embodiment, the invention provides a method for treating or lessening the severity of a CDK2-mediated disease or condition in a patient comprising the step of administering to said patient a composition according to the present invention.

[00192] The term "CDK2-mediated disease", as used herein means any disease or other deleterious condition in which CDK2 is known to play a role. Accordingly, these compounds

are useful for treating diseases or conditions that are known to be affected by the activity of CDK2 kinase. Such diseases or conditions include cancer, Alzheimer's disease, restenosis, angiogenesis, glomerulonephritis, cytomegalovirus, HIV, herpes, psoriasis, atherosclerosis, alopecia, and autoimmune diseases such as rheumatoid arthritis, viral infections, neurodegenerative disorders, disorders associated with thymocyte apoptosis, or proliferative disorders resulting from the deregulation of the cell cycle, especially of the progression from G_1 to S phase.

[00193] According to another embodiment, the invention provides a method for treating or lessening the severity of a CDK2-mediated disease or condition in a patient comprising the step of administering to said patient a composition according to the present invention.

[00194] The term "JNK-mediated condition", as used herein means any disease or other deleterious condition in which JNK is known to play a role. Such conditions include, without limitation, inflammatory diseases, autoimmune diseases, destructive bone disorders, proliferative disorders, cancer, infectious diseases, neurodegenerative diseases, allergies, reperfusion/ischemia in stroke, heart attacks, angiogenic disorders, organ hypoxia, vascular hyperplasia, cardiac hypertrophy, thrombin-induced platelet aggregation, and conditions associated with prostaglandin endoperoxidase synthase-2.

[00195] "JNK-mediated conditions" also include ischemia/reperfusion in stroke, heart attacks, myocardial ischemia, organ hypoxia, vascular hyperplasia, cardiac hypertrophy, hepatic ischemia, liver disease, congestive heart failure, pathologic immune responses such as that caused by T cell activation and thrombin-induced platelet aggregation.

[00196] In addition, JNK inhibitors of the instant invention may be capable of inhibiting the expression of inducible pro-inflammatory proteins. Therefore, other "JNK-mediated conditions" which may be treated by the compounds of this invention include edema, analgesia, fever and pain, such as neuromuscular pain, headache, cancer pain, dental pain and arthritis pain.

[00197] According to another embodiment, the invention provides a method for treating or lessening the severity of a ZAP-70-mediated disease or condition in a patient comprising the step of administering to said patient a composition according to the present invention.

[00198] The term "ZAP-70-mediated condition", as used herein means any disease or other deleterious condition in which ZAP-70 is known to play a role. Such conditions include, without limitation, autoimmune, inflammatory, proliferative and hyperproliferative diseases and

immunologically-mediated diseases including rejection of transplanted organs or tissues and Acquired Immunodeficiency Syndrome (AIDS).

[00199] For example, ZAP-70-mediated conditions include diseases of the respiratory tract including, without limitation, reversible obstructive airways diseases including asthma, such as bronchial, allergic, intrinsic, extrinsic and dust asthma, particularly chronic or inveterate asthma (e.g. late asthma airways hyper-responsiveness) and bronchitis. Additionally, ZAP-70 diseases include, without limitation, those conditions characterised by inflammation of the nasal mucus membrane, including acute rhinitis, allergic, atrophic thinitis and chronic rhinitis including rhinitis caseosa, hypertrophic rhinitis, rhinitis purulenta, rhinitis sicca and rhinitis medicamentosa; membranous rhinitis including croupous, fibrinous and pseudomembranous rhinitis and scrofoulous rhinitis, seasonal rhinitis including rhinitis nervosa (hay fever) and vasomotor rhinitis, sarcoidosis, farmer's lung and related diseases, fibroid lung and idiopathic interstitial pneumonia.

[00200] ZAP-70-mediated conditions also include diseases of the bone and joints including, without limitation, (pannus formation in) rheumatoid arthritis, seronegative spondyloarthropathis (including ankylosing spondylitis, psoriatic arthritis and Reiter's disease), Behcet's disease, Sjogren's syndrome and systemic sclerosis.

[00201] ZAP-70-mediated conditions also include diseases and disorders of the skin, including, without limiation, psoriasis, systemic sclerosis, atopical dermatitis, contact dermatitis and other eczmatous dermitides, seborrhoetic dermatitis, Lichen planus, Pemphigus, bullous Pemphigus, epidermolysis bullosa, urticaria, angiodermas, vasculitides, erythemas, cutaneous eosinophilias, uveitis, Alopecia, areata and vernal conjunctivitis.

[00202] ZAP-70-mediated conditions also include diseases and disorders of the gastrointestinal tract, including, without limitation, Coeliac disease, proctitis, eosinophilic gastro-enteritis, mastocytosis, pancreatitis, Crohn's disease, ulcerative colitis, food-related allergies which have effects remote from the gut, e.g. migraine, rhinits and eczema.

[00203] ZAP-70-mediated conditions also include those diseases and disorders of other tissues and systemic disease, including, without limiation, multiple scleroris, artherosclerosis, acquired immunodeficiency syndrome (AIDS), lupus erythematosus, systemic lupus, erythematosus, Hashimoto's thyroiditis, myasthenia gravis, type I diabetes, nephrotic syndrome, eosinophilia fascitis, hyper IgE syndrome, lepromatous leprosy, sezary syndrome and idiopathic

thrombocytopenia pupura, restenosis following angioplasty, tumours (for example leukemia, lymphomas), artherosclerosis, and systemic lupus erythematosus.

[00204] ZAP-70-mediated conditions also include allograft rejection including, without limitation, acute and chronic allograft rejection following for example transplantation of kidney, heart, liver, lung, bone marrow, skin and cornea; and chronic graft versus host disease.

[00205] It will also be appreciated that the compounds and pharmaceutically acceptable compositions of the present invention can be employed in combination therapies, that is, the compounds and pharmaceutically acceptable compositions can be administered concurrently with, prior to, or subsequent to, one or more other desired therapeutics or medical procedures. The particular combination of therapies (therapeutics or procedures) to employ in a combination regimen will take into account compatibility of the desired therapeutics and/or procedures and the desired therapeutic effect to be achieved. It will also be appreciated that the therapies employed may achieve a desired effect for the same disorder (for example, an inventive compound may be administered concurrently with another agent used to treat the same disorder), or they may achieve different effects (e.g., control of any adverse effects). As used herein, additional therapeutic agents that are normally administered to treat or prevent a particular disease, or condition, are known as "appropriate for the disease, or condition, being treated".

[00206] For example, chemotherapeutic agents or other anti-proliferative agents may be combined with the compounds of this invention to treat proliferative diseases and cancer. Examples of known chemotherapeutic agents include, but are not limited to, For example, other therapies or anticancer agents that may be used in combination with the inventive anticancer agents of the present invention include surgery, radiotherapy (in but a few examples, gamma.-radiation, neutron beam radiotherapy, electron beam radiotherapy, proton therapy, brachytherapy, and systemic radioactive isotopes, to name a few), endocrine therapy, biologic response modifiers (interferons, interleukins, and tumor necrosis factor (TNF) to name a few), hyperthermia and cryotherapy, agents to attenuate any adverse effects (e.g., antiemetics), and other approved chemotherapeutic drugs, including, but not limited to, alkylating drugs (mechlorethamine, chlorambucil, Cyclophosphamide, Melphalan, Ifosfamide), antimetabolites (Methotrexate), purine antagonists and pyrimidine antagonists (6-Mercaptopurine, 5-Fluorouracil, Cytarabile, Gemcitabine), spindle poisons (Vinblastine, Vincristine, Vinorelbine, Paclitaxel), podophyllotoxins (Etoposide, Irinotecan, Topotecan), antibiotics (Doxorubicin,

Bleomycin, Mitomycin), nitrosoureas (Carmustine, Lomustine), inorganic ions (Cisplatin, Carboplatin), enzymes (Asparaginase), and hormones (Tamoxifen, Leuprolide, Flutamide, and Megestrol), Gleevec™, adriamycin, dexamethasone, and cyclophosphamide. For a more comprehensive discussion of updated cancer therapies see, http://www.nci.nih.gov/, a list of the FDA approved oncology drugs at http://www.fda.gov/cder/cancer/druglistframe.htm, and The Merck Manual, Seventeenth Ed. 1999, the entire contents of which are hereby incorporated by reference.

[00207] Other examples of agents the inhibitors of this invention may also be combined with include, without limitation: treatments for Alzheimer's Disease such as Aricept® and Excelon®; treatments for Parkinson's Disease such as L-DOPA/carbidopa, entacapone, ropinrole, pramipexole, bromocriptine, pergolide, trihexephendyl, and amantadine; agents for treating Multiple Sclerosis (MS) such as beta interferon (e.g., Avonex® and Rebif®), Copaxone®, and mitoxantrone; treatments for asthma such as albuterol and Singulair®; agents for treating schizophrenia such as zyprexa, risperdal, seroquel, and haloperidol; anti-inflammatory agents such as corticosteroids, TNF blockers, IL-1 RA, azathioprine, cyclophosphamide, and sulfasalazine; immunomodulatory and immunosuppressive agents such as cyclosporin, tacrolimus, rapamycin, mycophenolate mofetil, interferons, corticosteroids, cyclophosphamide, azathioprine, and sulfasalazine; neurotrophic factors such as acetylcholinesterase inhibitors, MAO inhibitors, interferons, anti-convulsants, ion channel blockers, riluzole, and anti-Parkinsonian agents; agents for treating cardiovascular disease such as beta-blockers, ACE inhibitors, diuretics, nitrates, calcium channel blockers, and statins; agents for treating liver disease such as corticosteroids, cholestyramine, interferons, and anti-viral agents; agents for treating blood disorders such as corticosteroids, anti-leukemic agents, and growth factors; and agents for treating immunodeficiency disorders such as gamma globulin.

[00208] The amount of additional therapeutic agent present in the compositions of this invention will be no more than the amount that would normally be administered in a composition comprising that therapeutic agent as the only active agent. Preferably the amount of additional therapeutic agent in the presently disclosed compositions will range from about 50% to 100% of the amount normally present in a composition comprising that agent as the only therapeutically active agent.

[00209] The compounds of this invention or pharmaceutically acceptable compositions thereof may also be incorporated into compositions for coating implantable medical devices, such as prostheses, artificial valves, vascular grafts, stents and catheters. Accordingly, the present invention, in another aspect, includes a composition for coating an implantable device comprising a compound of the present invention as described generally above, and in classes and subclasses herein, and a carrier suitable for coating said implantable device. In still another aspect, the present invention includes an implantable device coated with a composition comprising a compound of the present invention as described generally above, and in classes and subclasses herein, and a carrier suitable for coating said implantable device.

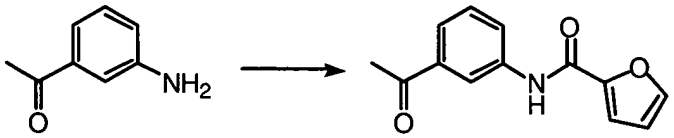
[00210] Vascular stents, for example, have been used to overcome restenosis (re-narrowing of the vessel wall after injury). However, patients using stents or other implantable devices risk clot formation or platelet activation. These unwanted effects may be prevented or mitigated by pre-coating the device with a pharmaceutically acceptable composition comprising a kinase inhibitor. Suitable coatings and the general preparation of coated implantable devices are described in US Patents 6,099,562; 5,886,026; and 5,304,121. The coatings are typically biocompatible polymeric materials such as a hydrogel polymer, polymethyldisiloxane, polycaprolactone, polyethylene glycol, polylactic acid, ethylene vinyl acetate, and mixtures thereof. The coatings may optionally be further covered by a suitable topcoat of fluorosilicone, polysaccarides, polyethylene glycol, phospholipids or combinations thereof to impart controlled release characteristics in the composition.

[00211] Another aspect of the invention relates to inhibiting JAK, JNK, CDK, and ZAP-70 activity in a biological sample or a patient, which method comprises administering to the patient, or contacting said biological sample with a compound of formula **I** or a composition comprising said compound. The term "biological sample", as used herein, includes, without limitation, cell cultures or extracts thereof; biopsied material obtained from a mammal or extracts thereof; and blood, saliva, urine, feces, semen, tears, or other body fluids or extracts thereof.

[00212] Inhibition of JAK, JNK, CDK, and ZAP-70 kinase activity in a biological sample is useful for a variety of purposes that are known to one of skill in the art. Examples of such purposes include, but are not limited to, blood transfusion, organ-transplantation, biological specimen storage, and biological assays.

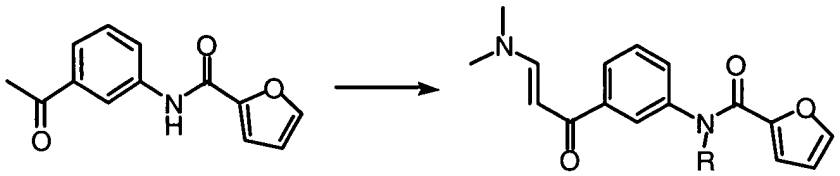
EXAMPLES

[00213] Example 1



[00214] **Furan-2-carboxylic acid (3-acetyl-phenyl)-amide.** To a solution of 1 g of 3-aminoacetophenone in 20 mL of CH_2Cl_2 was added 5 mL of ethyl-di-*iso*-propylamine. To the stirred reaction mixture was then added 1 mL of 2-furoyl chloride which was allowed to stir at 25 °C for 8 h. The reaction mixture was concentrated *in vacuo* and the residue was purified by silica gel chromatography (CH_2Cl_2) to yield 900 mg of furan-2-carboxylic acid (3-acetyl-phenyl)-amide as a white solid. ^{1}H NMR ($CDCl_3$, 500 MHz) δ 8.11 (1 H, br s), 8.09 (1H, t, J = 2 Hz), 7.93 (1 H, m), 7.66 (1H, m), 7.47 (1 H, m), 7.20 (1 H, m), 6.52 (1 H, m), 2.56 (3H, s) ppm.

[00215] Example 2

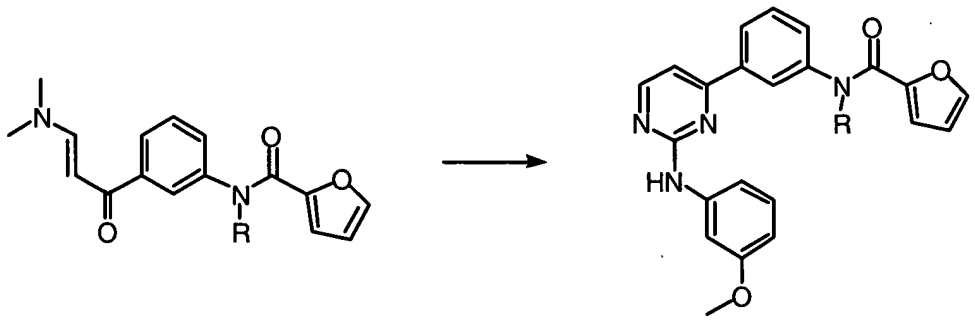


R = H, CH_3

[00216] **Furan-2-carboxylic acid [3-(3-dimethylamino-acryloyl)-phenyl]-methyl-amide and Furan-2-carboxylic acid [3-(3-dimethylamino-acryloyl)-phenyl]-amide.** A 25 mL round bottomed flask equipped with a stirbar was charged with 300 mg of furan-2-carboxylic acid (3-acetyl-phenyl)-amide as a solution in 5 mL of dimethylformamide-dimethyl acetal (DMF-DMA). The resulting reaction mixture was warmed to 100 °C for 8 h. The excess DMF-DMA was

removed *in vacuo,* and the residue was pushed through a plug of silica (Ethanol) to provide an inseparable mixture of furan-2-carboxylic acid [3-(3-dimethylamino-acryloyl)-phenyl]-methyl-amide and furan-2-carboxylic acid [3-(3-dimethylamino-acryloyl)-phenyl]-amide as a dark yellow oil (200 mg) which was used without further purification.

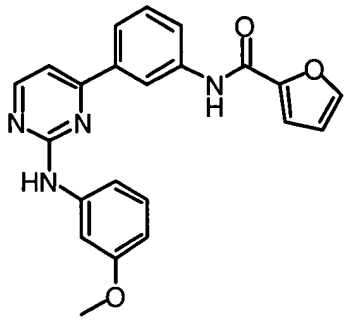
[00217] Example 3



R = H, CH_3

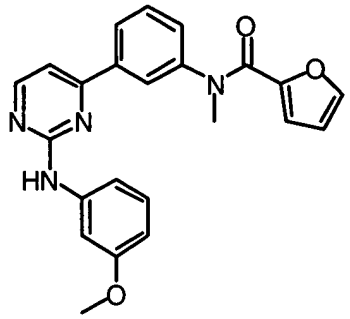
[00218] Furan-2-carboxylic acid {3-[2-(3-methoxy-phenylamino)-pyrimidin-4-yl]-phenyl}-amide and Furan-2-carboxylic acid {3-[2-(3-methoxy-phenylamino)-pyrimidin-4-yl]-phenyl}-methyl-amide. To a 25 mL round bottomed flask equipped with a stirbar was added 200 mg of furan-2-carboxylic acid [3-(3-dimethylamino-acryloyl)-phenyl]-methyl-amide and furan-2-carboxylic acid [3-(3-dimethylamino-acryloyl)-phenyl]-amide as a solution in 5 mL of DMF. To the stirred reaction was added sequentially 180 mg of 3-methoxylphenylguanidine and 200 mg of sodium methoxide. The resulting reaction mixture was allowed to stir at 100 °C for 8 h. The reaction mixture was poured into water (50 mL) and extracted with 2 x 50 mL of EtOAc. The organic layers were combined, dried over Na_2SO_4, and concentrated to a yellow oil which was purified by silica gel chromatography (8:1 CH_2Cl_2:EtOH) to yield 25 mg of furan-2-carboxylic acid {3-[2-(3-methoxy-phenylamino)-pyrimidin-4-yl]-phenyl}-amide and 25 mg of and 25 mg furan-2-carboxylic acid {3-[2-(3-methoxy-phenylamino)-pyrimidin-4-yl]-phenyl}-methyl-amide.

[00219] Example 4



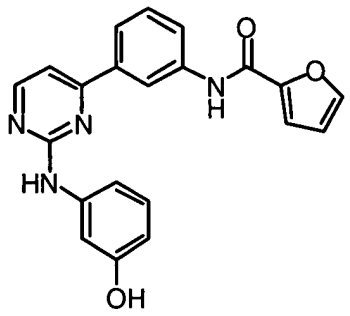
[00220] Furan-2-carboxylic acid {3-[2-(3-methoxy-phenylamino)-pyrimidin-4-yl]-phenyl}-amide ^{1}H NMR ($CDCl_3$, 500 MHz): δ8.40 (1 H, d, J = 5 Hz), 8.29 (1H, t, J = 2 Hz), 8.16 (1 H, s), 7.77 (2 H, m), 7.48 (1H, t, J = 2 Hz), 7.40 (1 H, t, J = 8 Hz), 7.30 (1 H, s), 7.19 (2 H, m), 7.08 (2 H, m), 6.53 (2 H, m), 3.77 (3 H, s) ppm. HPLC(purity, RT): >99% purity, 3.140 min. MS (FIA): 387.3 (M+H)

[00221] Example 5



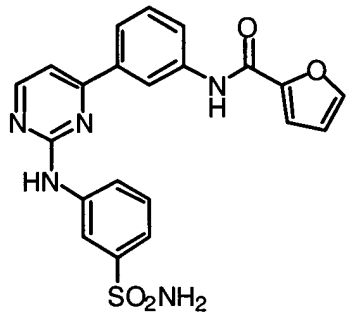
[00222] Furan-2-carboxylic acid {3-[2-(3-methoxy-phenylamino)-pyrimidin-4-yl]-phenyl}-methyl-amide. ^{1}H NMR ($CDCl_3$, 500 MHz): δ8.42 (1 H, d, J = 5 Hz), 7.99 (1H, d, J = 8 Hz), 7.93 (1 H, t, J = 2 Hz), 7.47 (2 H, m), 7.24 (3 H, m), 7.17 (2 H, t, J = 8 Hz), 7.05 (2 H, m), 6.55 (1 H, m), 6.14 (1 H, m), 5.99 (1 H, m), 3.75 (3 H, s), 3.43 (3 H, s) ppm. HPLC(purity, RT): >99% purity, 3.157 min. MS (FIA): 401.3 (M+H).

[00223] Example 6



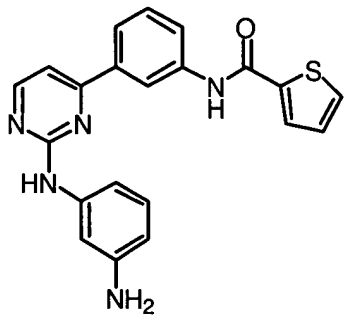
[00224] Furan-2-carboxylic acid {3-[2-(3-hydroxy-phenylamino)-pyrimidin-4-yl]-phenyl}-amide: ^{1}H NMR ($CDCl_3$, 500 MHz): δ8.42 (1 H, d, J = 5 Hz), 7.99 (1H, d, J = 8 Hz), 7.93 (1 H, t, J = 2 Hz), 7.47 (2 H, m), 7.24 (3 H, m), 7.17 (2 H, t, J = 8 Hz), 7.05 (2 H, m), 6.55 (1 H, m), 6.14 (1 H, m), 5.99 (1 H, m), 3.75 (3 H, s), 3.43 (3 H, s) ppm. HPLC(purity, RT): >99% purity, 3.289 min. MS (FIA): 373.3 (M+H)

[00225] Example 7



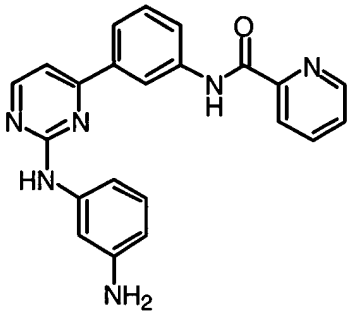
[00226] Furan-2-carboxylic acid {3-[2-(3-sulfamoyl-phenylamino)-pyrimidin-4-yl]-phenyl}-amide^{1}H NMR (DMSO-d_6, 500 MHz): δ 9.21 (1 H, s), 8.93 (1H, s), 8.61 (1 H, s), 8.52 (1 H, d, J = 6 Hz), 8.17 (1 H, d, J = 6 Hz), 7.95 (1 H, t, J = 3 Hz), 7.75 (1 H, m), 7.65 – 7.27 (8 H, m), 6.66 (2 H, m) ppm. HPLC(purity, RT): >99% purity, 3.250 min. MS (FIA): 436.2 (M+H)

[00227] Example 8



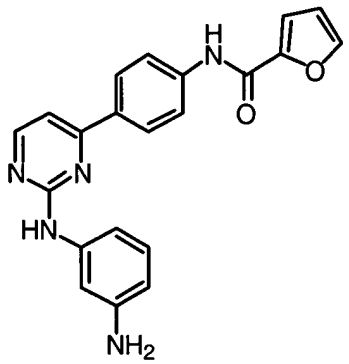
[00228] Thiophene-2-carboxylic acid{3-[2-(3-amino-phenylamino)-pyrimidin-4-yl]-phenyl}-amide: ^{1}H NMR (DMSO-d_6, 500 MHz): δ 10.79 (1H, s), 10.08 (1 H, s), 8.74 (1 H, s), 8.62 (1 H, d, *J* = 5 Hz), 8.37 (1 H, d, *J* = 3 Hz), 8.27 (1 H, s), 8.03 (1 H, d, *J* = 8 Hz), 7.90 (2 H, d, *J* = 4 Hz), 7.73 (1 H, d, *J* = 8 Hz), 7.54 (1 H, t, *J* = 8 Hz), 7.46-7.41 (2 H, m), 7.25 (1 H, t, *J* = 4 Hz), 7.0 (1 H, d, *J* = 8 Hz) ppm. HPLC(purity, RT): >99% purity, 2.57 min. MS (FIA): 388.3 (M+H).

[00229] Example 9



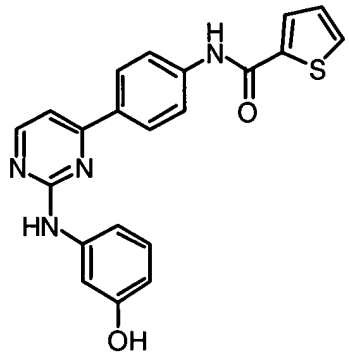
[00230] Pyridine-2-carboxylic acid {3-[2-(3-amino-phenylamino)-pyrimidin-4-yl]-phenyl}-amide: ^{1}H NMR ($CDCl_3$, 500 MHz): δ10.11 (1 H, s), 9.02 (1H, s), 8.56 (1 H, d, *J* = 4 Hz), 8.39 (1 H, d, *J* = 5 Hz), 8.19 (1 H, d, *J* = 8 Hz), 7.86-7.76 (1 H, m), 7.70 (1 H, d, *J* = 8 Hz), 7.53 (1 H, d, *J* = 7 Hz), 7.44-7.39 (2 H, m), 7.20 (1 H, d, *J* = 8 Hz), 7.13 (1 H, d, *J* = 5 Hz), 7.02 (1 H, t, *J* = 8 Hz), 6.60 (1 H, d, *J* = 7 Hz), 6.32 (1 H, d, *J* = 7 Hz) ppm. HPLC(purity, RT): 95% purity, 2.862 min. MS (FIA): 383.3 (M+H).

[00231] Example 10



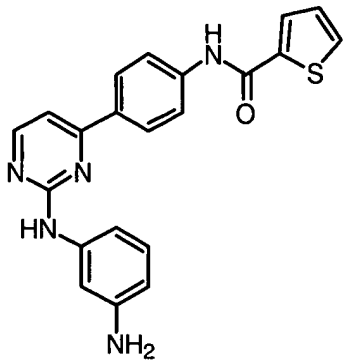
[00232] Furan-2-carboxylic acid {4-[2-(3-amino-phenylamino)-pyrimidin-4-yl]-phenyl}-amide: ^{1}H NMR (TFA, 500 MHz): δ7.69 (1 H, s), 7.53 (2H, br s), 7.34 (1 H, br s), 7.19 (2 H, br s), 7.10 (1 H, br s), 6.94 (1 H, br s), 6.89 (2 H, br s), 6.77 (1 H, m), 6.70 (1 H, m), 5.91 (1 H, m) ppm. HPLC(purity, RT): >99% purity, 2.619 min. MS (FIA): 373.3 (M+H).

[00233] Example 11



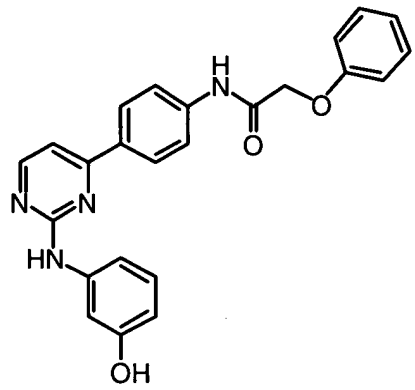
[00234] Thiophene-2-carboxylic acid {4-[2-(3-hydroxy-phenylamino)-pyrimidin-4-yl]-phenyl}-amide: ^{1}H NMR ($CDCl_3$, 500 MHz): δ9.79 (1 H, s), 8.90 (1H, s), 8.59 (1 H, s), 8.37 (1 H, s), 8.28 (1 H, s), 7.64 (1 H, d, J = 8 Hz), 7.51 (1 H, s), 7.38 (1 H, t, J = 8 Hz), 7.32 (1 H, d, J = 3 Hz), 7.16 (1 H, d, J = 5 Hz), 7.11-7.06 (2 H, m), 6.56-6.54 (2 H, m), 6.40 (1 H, d, J = 5 Hz) ppm. HPLC(purity, RT): >99% purity, 3.417 min. MS (FIA): 389.2 (M+H).

[00235] Example 12



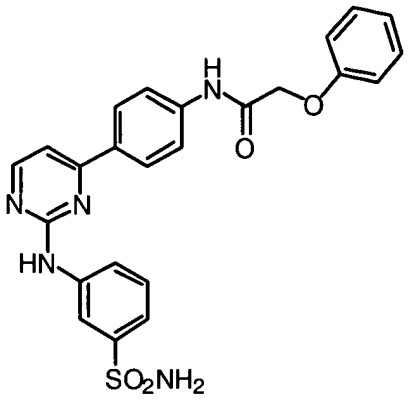
[00236] Thiophene-2-carboxylic acid {4-[2-(3-amino-phenylamino)-pyrimidin-4-yl]-phenyl}-amide: ^{1}H NMR (DMSO-d_6, 500 MHz): δ 10.79 (1H, s), 10.08 (1 H, s), 8.74 (1 H, s), 8.62 (1 H, d, *J* = 5 Hz), 8.37 (1 H, d, *J* = 3 Hz), 8.27 (1 H, s), 8.03 (1 H, d, *J* = 8 Hz), 7.90 (2 H, d, *J* = 4 Hz), 7.73 (1 H, d, *J* = 8 Hz), 7.54 (1 H, t, *J* = 8 Hz), 7.46-7.41 (2 H, m), 7.25 (1 H, t, *J* = 4 Hz), 7.0 (1 H, d, *J* = 8 Hz) ppm. HPLC(purity, RT): >99% purity, 2.739 min . MS (FIA): 388.3 (M+H).

[00237] Example 13



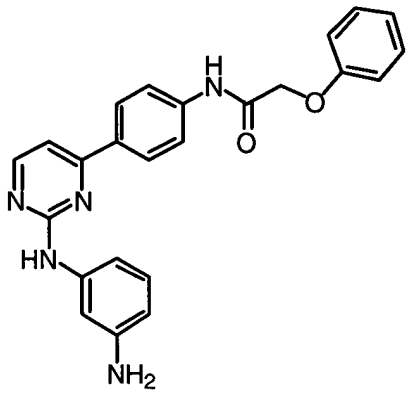
[00238] *N*-{4-[2-(3-Hydroxy-phenylamino)-pyrimidin-4-yl]-phenyl}-2-phenoxy-acetamide: ^{1}H NMR (MeOD, 500 MHz): δ 8.34 (1H, d, *J* = 5.5 Hz), 8.18 (2 H, d, *J* = 9 Hz), 7.82 (2 H, d, *J* = 7 Hz), 7.34-7.28 (4 H, m), 7.17 (1 H, t, *J* = 8 Hz), 7.09-6.99 (4 H, m), 6.56 (1 H, d, *J* = 7 Hz), 4.69 (2 H, s) ppm. HPLC(purity, RT): >99% purity, 3.046 min. MS (FIA): 413.3 (M+H).

[00239] Example 14



[00240] 2-Phenoxy-*N*-{4-[2-(3-sulfamoyl-phenylamino)-pyrimidin-4-yl]-phenyl}-acetamide: ^{1}H NMR (TFA, 500 MHz): δ9.87 (1H, s), 9.56 (1 H, d, *J* = 7 Hz), 9.45 (2 H, d, *J* = 9 Hz), 9.10 (1 H, d, *J* = 8 Hz), 9.03-9.00 (3 H, m), 8.91-8.85 (3 H, m), 8.80 (1 H, d, *J* = 7 Hz), 8.47-8.43 (3 H, m) 8.21-8.09 (4 h, m) 5.90 (2 H, s) ppm. HPLC(purity, RT): >99% purity, 3.073 min. MS (FIA): 476.3 (M+H).

[00241] Example 15:



[00242] *N*-{4-[2-(3-Amino-phenylamino)-pyrimidin-4-yl]-phenyl}-2-phenoxy-acetamide: ^{1}H NMR (MeOD, 500 MHz): δ8.38 (1H, d, *J* = 5.5 Hz), 8.14 (2 H, d, *J* = 9 Hz), 7.96 (1 H, s), 7.78 (2 H, d, *J* = 7 Hz), 7.33-7.22 (3 H, m), 7.06-6.96 (5 H, m), 6.43 (1 H, m), 4.68 (2 H, s) ppm. HPLC(purity, RT): >99% purity, 2.811 min. MS (FIA): 412.3 (M+H)

[00243] Additional compounds of the invention are prepared using the general methods described above and herein.

[00244] Example 16: JAK3 Inhibition Assay

[00245] Compound inhibition of JAK was assayed by the method described by G. R. Brown, *et al, Bioorg. Med. Chem. Lett.* 2000, vol. 10, pp 575-579 in the following manner. Into Maxisorb plates, previously coated at 4°C with Poly (Glu, Ala, Tyr) 6:3:1 then washed with phosphate buffered saline 0.05% and Tween (PBST), was added 2 μM ATP, 5 mM $MgCl_2$, and a solution of compound in DMSO. The reaction was started with JAK enzyme and the plates incubated for 60 minutes at 30°C. The plates were then washed with PBST, 100 μL HRP-Conjugated 4G10 antibody was added, and the plate incubated for 90 minutes at 30°C. The plate was again washed with PBST, 100 μL TMB solution is added, and the plates were incubated for another 30 minutes at 30°C. Sulfuric acid (100 μL of 1M) was added to stop the reaction and the plate is read at 450 nm, and K_i values were determined.

[00246] Certain compounds of this invention have K_is less than 5.0 micromolar (μM) in the JAK3 inhibition assay. In certain other embodiments, the following compounds have K_is of 1.0 μM or less in the JAK3 inhibition assay: **IV-A(i)-1, IV-A(i)-2, IV-A(i)-4, IV-A(i)-5, IV-A(i)-6, IV-B(i)-1, IV-B(i)-2, IV-B(i)-3, IV-B(i)-4, IV-B(i)-5, IV-B(i)-6, IV-B(i)-7, IV-B(i)-8, IV-B(i)-9, IV-B(i)-10, IV-B(i)-11, IV-C(i)-15**, and **IV-D(i)-2**.

[00247] Example 17: CDK2 Inhibition Assay

[00248] Compounds were screened for their ability to inhibit CDK-2/Cyclin A using a standard coupled enzyme assay (Fox et al (1998) *Protein Sci* 7, 2249). Reactions were carried out in 100 mM HEPES pH 7.5, 10 mM MgCl2, 25 mM NaCl, 1 mM DTT and 1.5% DMSO. Final substrate concentrations in the assay were 100 μM ATP (Sigma chemicals) and 100 μM peptide (American Peptide, Sunnyvale, CA). Assays were carried out at 30°C and 25 nM CDK-2/Cyclin A. Final concentrations of the components of the coupled enzyme system were 2.5 mM phosphoenolpyruvate, 350 μM NADH, 30 μg/ml pyruvate kinase and 10 μg/ml lactate dehydrogenase.

[00249] An assay stock buffer solution was prepared containing all of the reagents listed above, with the exception of CDK-2/Cyclin A, DTT and the test compound of interest. 56 μl of the test reaction was placed in a 384 well plate followed by addition of 1 μl of 2 mM DMSO

stock containing the test compound (final compound concentration 30 μM). The plate was preincubated for ~10 minutes at 30 °C and the reaction initiated by addition of 10 μl of enzyme (final concentration 25 nM). Rates of reaction were obtained using a BioRad Ultramark plate reader (Hercules, CA) over a 5 minute read time at 30°C and K_i values were determined.

[00250] Certain compounds of this invention have K_is less than 5.0 micromolar (μM) in the CDK2 inhibition assay. In certain other embodiments, the following compounds have K_is of 1.0 μM or less in the CDK2 inhibition assay: **IV-B(i)-2, IV-B(i)-11, IV-C(i)-2, IV-C(i)-3, IV-C(i)-4**, and **IV-D(i)-4**.

[00251] Example 18: JNK3 Inhibition Assays

[00252] Compounds were assayed for the inhibition of JNK3 by a spectrophotometric coupled-enzyme assay. In this assay, a fixed concentration of activated JNK3 (10 nM) was incubated with various concentrations of a potential inhibitor dissolved in DMSO for 10 minutes at 30°C in a buffer containing 0.1 M HEPES buffer, pH 7.5, containing 10 mM $MgCl_2$, 2.5 mM phosphoenolpyruvate, 200 μM NADH, 150 μg/mL pyruvate kinase, 50 μg/mL lactate dehydrogenase, and 200 μM EGF receptor peptide. The EGF receptor is a phosphoryl acceptor in the JNK3-catalyzed kinase reaction. The reaction was initiated by the addition of 10 μM ATP and the assay plate is inserted into the spectrophotometer's assay plate compartment that was maintained at 30°C. The decrease of absorbance at 340 nm was monitored as a function of time. The rate data as a function of inhibitor concentration was fitted to competitive inhibition kinetic model to determine the K_i.

[00253] Certain compounds of this invention have K_is less than 5.0 micromolar (μM) in the JNK3 inhibition assay. In certain other embodiments, the following compounds have K_is of 1.0 μM or less in the JNK3 inhibition assay: **IV-B(i)-2**, and **IV-B(i)-11**.

[00254] Example 18: ZAP-70 Inhibition Assay

[00255] Compounds are screened for their ability to inhibit ZAP-70 using a standard coupled enzyme assay (Fox et al., Protein Sci., (1998) **7**, 2249). Assays are carried out in a mixture of 100 mM HEPES 7.5, 10 mM $MgCl_2$, 25 mM NaCl , 2 mM DTT and 3% DMSO. Final substrate concentrations in the assay were 100 μM ATP (Sigma Chemicals) and 20 μM peptide (poly-4EY, Sigma Chemicals). Assays are carried out at 30 °C and 60 nM ZAP-70. Final

concentrations of the components of the coupled enzyme system were 2.5 mM phosphoenolpyruvate, 300 μM NADH, 30 μg/ml pyruvate kinase and 10 μg/ml lactate dehydrogenase.

[00256] An assay stock buffer solution is prepared containing all of the reagents listed above, with the exception of ZAP-70 and the test compound of interest. 55 μl of the stock solution is placed in a 96 well plate followed by addition of 2 μl of DMSO stock containing serial dilutions of the test compound (typically starting from a final concentration of 15μM). The plate is preincubated for 10 minutes at 30°C and the reaction initiated by addition of 10 μl of enzyme (final concentration 60 nM). Initial reaction rates are determined with a Molecular Devices SpectraMax Plus plate reader over a 15 minute time course. K_i data are calculated from non-linear regression analysis using the Prism software package (GraphPad Prism version 3.0a for Macintosh, GraphPad Software, San Diego California, USA).